International Energy Conservation Code
Consensus Committee-Commercial

Meeting Agenda (Draft 5/11)

May 18, 2022
2:00 PM Eastern to 5:00 PM Eastern (3 hours)
Webex Link

Committee Chair: Duane Jonlin
Committee Vice Chair: Emily Hoffman

1. Call to order.

2. Meeting Conduct. Staff
   a. Identification of Representation/Conflict of Interest
   b. ICC Council Policy 7 Committees: Section 5.1.10 Representation of Interests
   c. ICC Code of Ethics: ICC advocates commitment to a standard of professional behavior that exemplifies the highest ideals and principles of ethical conduct which include integrity, honesty, and fairness. As part of this commitment it is expected that participants shall act with courtesy, competence and respect for others.
   d. ICC Antitrust Compliance Guideline

3. Roll Call – Hoffman

4. Approval of Agenda

5. Approval of Minutes

6. Administrative issues.
   a. Progress indicators

7. Action Items.
   a. Code Change Proposals

CEPI-193-21 (Energy & Demand Resp Credit) (Modeling to hear 5/16)
CEPI-27-21 (Thermal Envelope) (Envelope as modified 17-0-1)
CEPI-30-21 (Thermal Bridging Masonry) (Envelope disapprove 12-9-2)
CEPI-46-21 (Component Performance Alt) (Envelope as modified 14-3-4)
CEPI-4-21 (Above Base Code Appendix) (Envelope disapprove 16-6-1)
CEPI-204-21 (Performance Path backstop) (Envelope disapprove 17-2-2)
CEPI-210-21 (Perf Fenestration backstop) (Envelope disapprove 13-6-2)
CEPI-214-21 (Commissioning Envelope) (Envelope disapprove 11-2-4)
CEPI-241-21 (Net zero backstop) (Envelope disapprove 11-6-4)
CECPI-5-21 (Zero Energy Building Appendix)(Modeling approve 16-0-1)
CEPI-64-21 (HVAC operable opening excep) (HVACR disapprove 17-0-0)
CEPI-65-21 (Operable opening interlocking) (HVACR as modified 16-0-1)
CECPI-7-21 (Interior LPD Committee Proposal) (Electrical as modified 15-1-1)
CEPI-171-21 (Façade lighting) (Electrical disapprove 9-8-2)
CEPI-172-21 (Lighting business closing) (Electrical approve 15-2-2)
CEPI-173-21 (Lighting parking lot activity sensors) (Electrical approve 14-2-3)
CEPI-174-21 (Lighting setback) (Electrical disapprove 16-3-1)
CEPI-186-21 (Lighting sys. Perf. Alt. compliance) (Electrical disapprove 16-1-2)
CEPI-189-21 (Lighting exterior updates) (Electrical as modified 17-0-1)

8. Subcommittee & Temporary Work Group reports
    a. Envelope and Embodied Energy- Culp
    b. Electrical Power, Lighting, and Renewables-Jouaneh
    c. HVACR & Water Heating-Shelide
    d. Modeling, Whole-Building Metrics, Zero Energy-Eades
    e. Construction Cost & LCC Update- Tillou

9. Other business.
    a. Public comment on any matters discussed at the meeting (Please limit comments to 2 minutes. Further comments can be directed to the Secretariat following the meeting to be considered at a future meeting.)

10. “3 Minutes of Fame.” Speakers TBD

11. Upcoming meetings.

12. Adjourn.

FOR FURTHER INFORMATION BE SURE TO VISIT THE ICC WEBSITE:
IECC Commercial Consensus Committee Webpage
https://www.iccsafe.org/products-and-services/i-codes/code-development/cs/iecc-commercial-consensus-committee/
ICC Energy webpage
https://www.iccsafe.org/products-and-services/codes-standards/energy/
Code Change Proposal Submittals
https://energy.cdpaccess.com/login/
Energy Complete Monograph
Monograph

FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

Kristopher Stenger, AIA, Director of Energy Programs
International Code Council
kstenger@iccsafe.org

As Modified

Revised items noted in "As Modified Reason Statement"

Note: some new equations and tables not shown underlined for clarity throughout

CEPI-193-21

IECC®: SECTION C406, SECTION 406 (New), C406.1 (New), C406.1.1 (New), Table C406.1.1 (New), C406.1.1.1 (New), C406.1.2 (New), Table C406.1.2 (New), C406.1.3 (New), C406.2 (New), Table C406.2(1) (New), Table C406.2(2) (New), Table C406.2(3) (New), Table C406.2(4) (New), Table C406.2(5) (New), Table C406.2(6) (New), Table C406.2(7) (New), Table C406.2(8) (New), Table C406.2(9) (New), C406.2 (New), C406.2.1 (New), C406.2.1.1 (New), C406.2.1.2 (New), C406.2.1.3 (New), C406.2.1.3.1 (New), C406.2.1.3.2 (New), C406.2.1.3.3 (New), C406.2.1.4 (New), C406.2.1.4.1 (New), C406.2.1.4.2 (New), C406.2.1.5 (New), C406.2.1.5.1 (New), C406.2.1.5.2 (New), C406.2.1.6 (New), Table C406.2.1.6 (New), C406.2.2 (New), C406.2.2.1 (New), C406.2.2.2 (New), C406.2.2.3 (New), C406.2.2.4 (New), C406.2.2.5 (New), C406.2.3 (New), C406.2.3.1 (New), C406.2.3.3 (New), C406.2.3.4 (New), C406.2.3.5 (New), Table C406.2.3.5 (New), C406.2.3.6 (New), C406.2.4 (New), C406.2.5 (New), C406.2.5.1 (New), C406.2.5.2 (New), C406.2.5.3 (New), C406.2.5.4 (New), TABLE C406.2.5.4 (New), C406.2.5.5 (New), C406.2.5.6 (New), C406.2.7 (New), C406.2.7.1 (New), C406.2.7.2 (New), Table C406.2.7.2(1) (New), Table C406.2.7.2(2) (New), TABLE C406.2.7.2(3) (New), Table C406.2.7.2(4) (New), C406.2.7.3 (New), C406.2.7.4 (New), C406.3 (New), Table C406.3(1) (New), Table C406.3(2) (New), Table C406.3(3) (New), Table C406.3(4) (New), Table C406.3(5) (New), Table C403.6(6) (New), Table C406.3(7) (New), Table C406.3(8) (New), Table C406.3(9) (New), C406.3.1 (New), Table 406.3.1 (New), Table C406.3.1 (New), C406.3.2 (New), G406.3.3 (New), C406.3.4 (New), C406.3.5 (New), C403.6.6 (New), G406.3.7 (New), C406.3.8 (New), C407.2, TABLE C407.2, APPENDIX CD (New), CD101 (New), CD101.1 (New), CD101.2 (New), CD102 (New), CD102.1 (New), Table CD102.1 (New), ANSI Chapter 06 (New), IEC (New), IEC (New), OpenADR (New) Proponents:

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

2021 International Energy Conservation Code

Add the following definition:

SENSIBLE ENERGY RECOVERY RATIO*:* change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and entering exhaust air dry-bulb temperatures, expressed as a percentage.

Delete without substitution:
~~**SECTION C406 ADDITIONAL EFFICIENCY REQUIREMENTS**~~
Add new text as follows:

SECTION 406 ADDITIONAL EFFICIENCY, RENEWABLE, and LOAD MANAGEMENT REQUIREMENTS

C406.1 Compliance.

Buildings shall comply as follows:

1. *Buildings* with greater than 2000 square feet (190 m^2) of floor area shall comply with Section C406.1.1.
2. *Buildings* with greater than 5000 square feet (465 m^2) *of conditioned floor area* shall comply with Sections C406.1.1 and C406.1.2.
3. Build-out construction greater than 1000 square feet (93 m^2) of *conditioned floor area* that does not have final lighting or final HVAC systems installed under a prior building permit shall comply with Section C406.1.3.

   Exception: Core and shell *buildings* where no less than 20 percent of the *net floor area* is without final lighting or final HVAC that comply with all of the following:

   1. *Buildings* with greater than 5000 square feet (465 m^2) of *conditioned floor area* shall comply with Section C406.1.2
   2. Portions of the *building* where the *net floor area* is without final lighting or final HVAC shall comply with Section C406.1.3
   3. Portions of the building where the *net floor area* has final lighting and final HVAC systems shall comply with C406.1.1.

C406.1.1 Additional energy efficiency credit requirements.

Buildings shall comply with measures from C406.2 to achieve not less than the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone.

Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

Exceptions:

1. Unconditioned parking garages that achieve 50% of the credits required for use groups S-1 and S-2 in Table C406.1.1.
2. Portions of *buildings* devoted to manufacturing or industrial use.

Table C406.1.1 Energy Credit Requirements by Building Occupancy Group

Building Occupancy Group	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	65	66	67	77	80	86	80	81	90	86	90	90	86	90	90	79	89	80	78
I-2	43	42	38	37	36	38	32	32	30	36	36	35	43	43	44	46	47	50	53
R-1	63	62	66	65	70	71	77	80	84	81	83	88	85	86	90	83	87	87	85
B	62	62	64	66	66	65	64	64	68	70	72	74	71	73	77	71	74	74	71
A-2	70	70	72	72	75	75	70	73	82	69	74	78	67	72	78	60	67	57	51
M	80	79	83	79	81	84	67	74	87	80	66	65	79	62	50	75	67	75	58
E	56	57	55	58	58	57	59	62	59	61	66	62	64	67	67	65	67	63	58
S-1 and S-2	61	60	61	60	58	57	44	54	62	85	68	75	90	82	72	90	89	90	90
All Other	31	31	31	32	32	33	30	32	36	35	35	35	37	36	36	36	37	36	34

C406.1.2 Additional renewable and load management credit requirements.

Buildings shall comply with measures from C406.3 to achieve not less than the number of required renewable and load management credits from Table C406.1.2 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.2 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

Table C406.1.2 Renewable and Load Management Credit Requirements by Building Occupancy Group

Building Occupancy Group	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	64	59	70	69	73	89	72	90	90	63	90	70	51	75	66	48	58	50	42
I-2	31	32	33	32	33	36	31	40	34	32	43	32	29	37	33	34	33	27	23
R-1	41	40	48	44	48	58	54	61	63	50	61	47	42	55	50	41	51	40	32
B	63	64	74	75	78	89	83	90	90	77	90	86	68	90	83	72	81	68	58
A-2	12	12	13	13	12	17	13	17	17	12	17	13	12	12	12	12	12	8	7
M	71	70	84	84	90	90	90	90	90	81	90	90	77	90	90	76	84	71	58
E	49	55	64	61	69	83	73	90	90	67	90	75	61	86	74	66	76	60	47
S-1 and S-2	90	90	90	90	90	90	90	90	90	90	90	90	70	90	90	61	85	61	53
All Other	56	55	66	63	69	80	69	87	88	59	86	68	51	72	66	51	60	48	40

C406.1.3 Core and Shell Buildings and Build-Out Construction.

Where separate permits are issued for core and shell *buildings* and build-out construction, compliance shall be in accordance with the following requirements.

1. Core and shell *buildings* or portions of *buildings* shall comply with one of the following:

1.1 Where the permit includes a central HVAC system or service water heating system with chillers, heat pumps, boilers, service water heating equipment, or loop pumping systems with heat rejection, the project shall achieve not less than 50 percent of the energy credits required in Table C406.1.1 in accordance with Section C406.2.

1.2 Alternatively, the project shall achieve not less than 33 percent of the energy credits required in Table C406.1.1.

2. For core and shell *buildings* or portions of *buildings* the energy credits achieved shall be subject to the following adjustments:

2.1 Lighting measure credits shall be determined only for areas with final lighting installed.

2.2 Where HVAC or service water heating systems are designed to serve the entire building, full HVAC or service water heating measure credits shall be achieved

2.3 Where HVAC or service water heating systems are designed to serve individual areas, HVAC or service water heating measure credits achieved shall be reduced in proportion to the floor area with final HVAC systems or final service water heating systems installed

3. Build-out construction shall be deemed to comply with Section C406.1 where either:

3.1 Where heating and cooling generation are provided by a previously installed central system, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 33 percent of the credits required in Table C406.1.1

3.2 Where heating and cooling generation are provided by an HVAC system installed in the build out, the energy credits achieved in accordance with Section C406.2 under the build-out project are not less than 50 percent of the credits required in Table C406.1.1

3.3 Where the core and shell building was *approved* in accordance with C407 under 2021 IECC or later.

C406.2 Additional Energy Efficiency Credits Achieved.

Each energy efficiency credit measure used to meet credit requirements for the project shall have efficiency that is greater than the requirements in Sections C402 through C405. Measures installed in the project that meet the requirements in Sections C406.2.1 through C406.2.7 shall achieve the base credits listed for the measure and occupancy type in Tables C406.2(1) through C406.2(9) or, where calculations required by Sections C406.2.1 through C406.2.7 create or modify the table credits, the credits achieved shall be based upon the calculations. Energy credits achieved for measures shall be determined by one of the following, as applicable:

1. The measure's energy credit shall be the base energy credit for the measure where no adjustment factor or calculation is included in the description of the measure in Section C406.2.
2. The measure's energy credit shall be the base energy credit for the measure adjusted by a factor or equation as stated in the description of the measure in Section C406.2. Where adjustments are applied, each measure's energy credit shall be rounded to the nearest whole number.
3. The measure's energy credit shall be by calculation as stated in the measure's description in Section C406.2, where each individual measure credit shall be rounded to the nearest whole number.

Energy credits achieved for the project shall be the sum of the individual measure's energy credits. Credits are available for the measures listed in this Section. Where a project contains multiple building occupancy groups:

1. Credits achieved for each occupancy group shall be summed and then weighted by the floor area of each occupancy group to determine the weighted average project energy credits achieved.

2. Credits for improved envelope efficiency and lighting reduction (L06) shall be determined for the *building* or permitted floor area as a whole. Credits for other measures shall be taken from applicable tables or calculations weighted by the building occupancy group floor area.

Table C406.2(1) Base Energy Credits for Group R-2, R-4, and I-1 Occupancies [a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	8	13	7	11	6	8	9	6	1	24	8	9	30	15	5	32	28	31	36
E03	Envelope leakage reduction	C406.2.1.3	15	10	12	8	6	16	13	5	1	47	7	9	65	16	1	73	43	52	26
E04	Add Roof Insulation	C406.2.1.4	1	1	1	1	1	1	4	3	1	5	3	4	6	5	1	7	7	6	8
E05	Add Wall Insulation	C406.2.1.5	10	10	6	8	5	6	8	4	1	8	3	4	11	7	1	14	12	13	13
E06	Improve Fenestration	C406.2.1.6	7	7	4	6	9	11	13	3	1	22	5	10	27	18	7	41	33	22	21
H01	HVAC Performance	C406.2.2.1	20	19	16	17	14	13	11	11	5	13	10	8	15	12	7	18	14	17	19
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	3	1	1	6	2	3	10	5	2	14	10	13	16
H03	Cooling efficiency	C406.2.2.3	7	6	4	4	3	3	1	1	1	1	1	1	1	1	x	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	9	10	8	22	20	25	16	17	32	21	24	17	23	27	16	21	24	18	18
H05	DOAS/fan control	C406.2.2.5	32	31	27	28	23	23	28	21	12	42	24	24	56	36	19	73	54	70	79
W01	SHW preheat recovery	C406.2.3.1 a	61	63	74	74	85	88	101	100	121	103	109	122	102	111	130	93	106	99	96
W02	Heat pump water heater	C406.2.3.1 b	50	52	62	61	72	74	86	85	104	88	94	106	88	96	112	81	92	87	84
W03	Efficient gas water heater	C406.2.3.1 c	38	39	46	46	53	55	63	62	76	64	68	76	64	69	81	58	66	62	60
W04	SHW pipe insulation	C406.2.3.2	7	7	8	7	8	8	8	9	10	8	9	9	7	8	9	6	7	6	6
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	3	3	3	3	3	3	3	3	4	3	3	4	3	3	4	3	3	3	2
W07	SHW heat trace system	C406.2.3.3 c	12	12	13	13	14	15	15	15	18	14	15	16	13	14	16	11	13	11	10
W08	SHW submeters	C406.2.3.4	11	11	13	13	15	16	18	18	22	19	20	22	19	20	24	17	20	18	18
W09	SHW flow reduction	C406.2.3.5	45	46	55	54	63	65	74	73	89	75	80	89	74	81	95	68	77	72	70
W10	Shower heat recovery	C406.2.3.6	15	16	19	19	22	23	26	26	32	27	29	32	27	29	34	25	28	27	26
P01	Energy monitoring	C406.2.4	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2	3	2	2	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L03	Increase occp. sensor	C406.2.5.3	3	3	4	4	4	4	3	4	3	2	3	2	1	2	2	1	1	1	1
L04	Increase daylight area	C406.2.5.4	5	5	5	5	5	5	4	4	4	4	4	3	3	4	3	2	3	3	2
L05	Residential light control	C406.2.5.5	8	8	9	9	9	9	8	8	10	6	8	7	4	6	8	3	5	4	3
L06	Light power reduction	C406.2.5.7	2	2	2	2	2	2	2	2	2	1	2	1	1	1	1	1	1	1	1
Q01	Efficient elevator	C406.2.7.1	4	4	4	4	5	5	5	5	5	4	5	5	4	4	5	4	4	4	3
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	15	15	17	16	17	18	17	18	20	16	17	18	15	16	18	13	15	13	12

Q04	Fault detection	C406.2.7.4	3	3	2	3	2	2	2	2	1	2	2	1	2	2	1	3	2	3	3

[a] "x" indicates credit is not available for that measure

Table C406.2(2) Base Energy Credits for Group I-2 Occupancies [a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	6	11	6	11	7	9	6	6	2	3	3	3	4	3	7	5	5	17	3
E03	Envelope leakage reduction	C406.2.1.3	5	3	4	3	5	8	8	3	2	6	2	2	7	3	1	9	7	19	5
E04	Add Roof Insulation	C406.2.1.4	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	2	3
E05	Add Wall Insulation	C406.2.1.5	1	3	1	3	2	2	9	4	1	4	1	1	3	1	1	3	3	3	3
E06	Improve Fenestration	C406.2.1.6	1	1	1	1	1	1	1	1	1	4	3	5	5	1	1	5	5	2	2
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	2	3	4	3	7	6	4	6	8	6	10	11	12	15	19
H03	Cooling efficiency	C406.2.2.3	6	6	4	4	3	3	2	2	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	41	41	40	40	42	36	42	37	39	49	40	46	56	46	61	65	68	82	93
W01	SHW preheat recovery	C406.2.3.1 a	4	4	4	4	5	5	5	5	6	6	6	6	6	6	6	6	5	5	5
W02	Heat pump water heater	C406.2.3.1 b	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3
W03	Efficient gas water heater	C406.2.3.1 c	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
W04	SHW pipe insulation	C406.2.3.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
P01	Energy monitoring	C406.2.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	5	5	5	6	5	6	6	5	6	6	5	5	5	4	4	3	2
L03	Increase occp. sensor	C406.2.5.3	5	5	5	5	5	5	5	5	6	5	5	6	5	5	5	4	4	3	2
L04	Increase daylight area	C406.2.5.4	7	7	7	7	7	7	7	7	8	6	6	6	6	6	5	5	5	5	4
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	7	7	7	7	7	7	7	7	9	7	7	8	6	7	7	5	5	4	3

Q01	Efficient elevator	C406.2.7.1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	3	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3	4	4

[a]."x" indicates credit is not available for that measure

Table C406.2(3) Base Energy Credits for Group R-1 Occupancies [a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	8	12	7	12	6	8	6	7	13	8	5	3	9	7	3	13	12	18	26
E03	Envelope leakage reduction	C406.2.1.3	15	9	12	8	6	16	7	5	10	14	3	1	19	5	1	28	16	28	18
E04	Add Roof Insulation	C406.2.1.4	1	1	1	2	2	1	2	1	1	2	1	2	2	1	2	3	2	2	3
E05	Add Wall Insulation	C406.2.1.5	18	26	11	25	3	4	5	3	1	6	2	4	7	4	4	8	6	8	5
E06	Improve Fenestration	C406.2.1.6	2	2	1	2	2	3	5	3	1	6	3	4	9	7	6	13	8	6	6
H01	HVAC Performance	C406.2.2.1	21	20	17	18	16	13	12	12	11	11	11	8	11	11	8	13	11	14	16
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	1	1	6	2	1	1	3	2	2	6	4	8	11
H03	Cooling efficiency	C406.2.2.3	7	6	4	4	3	2	1	2	1	1	2	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	32	30	26	28	25	23	24	22	28	26	22	20	30	26	19	41	34	48	62
W01	SHW preheat recovery	C406.2.3.1 a	18	19	22	22	25	27	31	31	32	34	34	38	37	36	40	36	37	36	35
W02	Heat pump water heater	C406.2.3.1 b	14	15	18	17	20	22	25	25	27	29	29	32	31	31	34	30	32	31	30
W03	Efficient gas water heater	C406.2.3.1 c	11	12	14	14	16	17	19	19	20	21	21	24	23	23	25	22	23	23	22
W04	SHW pipe insulation	C406.2.3.2	3	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	1	1
W07	SHW heat trace system	C406.2.3.3 c	5	6	6	6	6	7	7	7	7	7	7	8	7	7	8	7	7	6	6
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	13	14	16	16	18	20	22	22	23	25	25	28	27	26	29	26	27	26	25
W10	Shower heat recovery	C406.2.3.6	4	5	5	5	6	7	8	8	8	9	9	10	10	9	10	9	10	10	9
P01	Energy monitoring	C406.2.4	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
L03	Increase occp. sensor	C406.2.5.3	3	3	3	3	3	3	3	3	4	2	3	3	2	2	3	2	2	1	1

L04	Increase daylight area	C406.2.5.4	4	5	5	4	5	5	4	4	5	4	4	4	3	4	3	3	3	3	2
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	1	1	2	2	2	2	2	2	2	1	2	2	1	1	2	1	1	1	1
Q01	Efficient elevator	C406.2.7.1	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	2	2	2	2
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	9	9	10	10	10	11	11	11	11	11	11	12	11	11	12	10	11	10	9
Q04	Fault detection	C406.2.7.4	3	3	3	3	2	2	2	2	2	2	2	1	2	2	1	2	2	2	2

[a] "x" indicates credit is not available for that measure

Table C406.2(4) Base Energy Credits for Group B Occupancies [a]

ID	Energy Credit Measure	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	4	7	4	7	3	4	7	2	1	7	2	3	10	6	4	12	9	19	11
E03	Envelope leakage reduction	C406.2.1.3	5	3	4	2	2	2	5	1	1	8	1	2	13	4	1	18	9	18	7
E04	Add Roof Insulation	C406.2.1.4	2	2	2	2	2	2	3	2	1	3	1	2	3	2	2	3	3	2	3
E05	Add RWall Insulation	C406.2.1.5	13	14	8	11	4	4	7	4	1	5	2	4	6	4	3	9	7	10	8
E06	Improve Fenestration	C406.2.1.6	5	5	4	5	7	7	8	2	1	8	2	4	10	5	1	21	17	10	9
H01	HVAC Performance	C406.2.2.1	22	22	19	20	17	17	15	15	11	15	15	11	16	15	11	19	17	18	20
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	1	1	1	3	2	2	5	4	3	9	7	8	12
H03	Cooling efficiency	C406.2.2.3	7	6	4	5	3	3	1	2	1	1	2	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	31	31	27	29	25	25	28	26	18	35	28	28	47	38	29	64	53	58	74
W01	SHW preheat recovery	C406.2.3.1 a	8	9	10	9	11	11	12	12	14	13	13	14	13	13	15	12	13	14	14
W02	Heat pump water heater	C406.2.3.1 b	3	3	3	3	4	4	5	4	5	5	5	6	5	5	6	5	5	6	6
W03	Efficient gas water heater	C406.2.3.1 c	5	5	6	6	7	7	8	7	8	8	8	9	8	8	9	8	8	9	8
W04	SHW pipe insulation	C406.2.3.2	3	3	4	4	4	4	4	4	5	4	4	5	4	4	5	4	4	4	4
W05	Point of use water heaters	C406.2.3.3 a	12	15	17	16	18	18	19	19	22	20	20	22	20	20	22	18	19	20	19
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	4	4	4	4	5	5	5	5	6	5	5	6	5	5	6	5	5	5	5
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P01	Energy monitoring	C406.2.4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	6	6	6	6	6	6	7	6	6	6	5	5	6	4	5	3	2
L03	Increase occp. sensor	C406.2.5.3	5	6	6	6	6	6	6	6	8	6	6	6	5	5	6	4	5	4	3
L04	Increase daylight area	C406.2.5.4	7	7	8	8	8	8	8	8	9	6	7	7	6	6	6	6	6	7	5
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	7	7	8	8	8	8	8	8	9	7	8	8	6	7	8	5	6	5	3

Q01	Efficient elevator	C406.2.7.1	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	4	5	4	4
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	3	3	3	3

[a.] **"**x" indicates credit is not available for that measure building occupancy in that climate zone

Table C406.2(5) Base Energy Credits for Group A-2 Occupancies [a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	1	1	1	1	2	2	9	2	1	19	4	5	26	7	3	33	23	29	13
E03	Envelope leakage reduction	C406.2.1.3	2	1	1	1	2	3	11	2	1	24	4	6	33	9	3	42	29	36	16
E04	Add Roof Insulation	C406.2.1.4	1	1	0	1	1	1	2	1	1	1	1	1	2	2	1	2	2	1	2
E05	Add Wall Insulation	C406.2.1.5	1	1	0	1	1	2	3	3	1	2	1	2	2	2	2	2	2	2	2
E06	Improve Fenestration	C406.2.1.6	1	1	1	1	1	1	2	2	1	1	2	2	3	2	1	4	4	1	1
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	1	1	6	3	3	10	6	8	15	11	10	19	15	23	28
H03	Cooling efficiency	C406.2.2.3	6	5	3	4	3	2	1	1	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	29	27	20	25	24	21	36	27	15	51	35	38	67	53	45	84	70	97	115
W01	SHW preheat recovery	C406.2.3.1 a	24	26	31	29	33	35	37	38	45	38	41	44	37	40	44	34	38	33	30
W02	Heat pump water heater	C406.2.3.1 b	15	16	19	18	21	23	25	25	29	26	28	30	26	28	31	25	27	24	22
W03	Efficient gas water heater	C406.2.3.1 c	15	16	19	18	21	22	23	24	28	24	25	27	23	25	27	21	24	21	18
W04	SHW pipe insulation	C406.2.3.2	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	2	2	2
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3	3	3	3
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P01	Energy monitoring	C406.2.4	2	2	2	2	2	1	2	1	1	2	1	1	2	2	1	2	2	2	3
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1	1	1	0
L03	Increase occp. sensor	C406.2.5.3	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0
L04	Increase daylight area	C406.2.5.4	3	3	3	3	3	3	2	2	2	2	2	2	1	2	1	1	1	1	1
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	1	2	1	1

Q01	Efficient elevator	C406.2.7.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Q02	Commercial kitchen equip.	C406.2.7.2	24	26	28	27	28	29	27	29	32	26	28	29	24	26	28	21	23	19	17
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	3	2	2	2	2	2	2	2	1	2	2	1	2	2	2	3	2	3	4

[a] "x" indicates credit is not available for that measure

Table C406.2(6) Base Energy Credits for Group M Occupancies [a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	2	2	2	2	2	3	15	2	1	36	5	9	45	11	5	51	36	35	15
E03	Envelope leakage reduction	C406.2.1.3	3	3	2	2	3	3	19	3	1	44	6	11	56	13	6	64	44	43	19
E04	Add Roof Insulation	C406.2.1.4	8	6	5	7	7	7	18	16	4	19	18	20	21	22	23	24	26	24	30
E05	Add Wall Insulation	C406.2.1.5	64	65	48	62	13	15	23	18	4	27	21	27	25	24	25	23	24	24	16
E06	Improve Fenestration	C406.2.1.6	4	3	3	3	4	4	6	5	2	7	5	7	7	5	7	10	10	3	3
H01	HVAC Performance	C406.2.2.1	31	30	26	28	23	21	23	20	14	27	21	22	29	25	23	32	28	30	33
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	10	3	1	19	8	15	26	17	18	29	24	27	31
H03	Cooling efficiency	C406.2.2.3	10	9	7	7	5	4	2	2	1	1	2	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	48	48	42	47	40	38	66	46	31	98	61	82	120	91	90	134	115	125	141
W01	SHW preheat recovery	C406.2.3.1 a	12	13	16	15	18	20	19	21	26	17	21	21	16	19	21	13	16	15	13
W02	Heat pump water heater	C406.2.3.1 b	3	3	4	3	4	5	5	5	7	5	6	6	4	5	6	4	4	4	4
W03	Efficient gas water heater	C406.2.3.1 c	6	7	8	8	10	10	10	11	14	9	11	11	8	10	11	7	8	8	7
W04	SHW pipe insulation	C406.2.3.2	3	3	4	4	4	4	4	4	5	4	4	5	4	4	5	4	4	4	4
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	4	4	4	4	5	5	5	5	6	5	5	6	5	5	6	5	5	5	5
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P01	Energy monitoring	C406.2.4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	9	9	11	10	12	13	11	13	15	9	12	11	7	9	10	5	7	5	3
L03	Increase occp. sensor	C406.2.5.3	9	9	11	10	12	13	12	13	15	10	12	11	7	10	11	6	8	5	4
L04	Increase daylight area	C406.2.5.4	12	13	15	14	16	17	15	16	20	11	14	13	9	12	11	8	10	10	8
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	12	12	14	14	15	16	12	15	19	8	12	9	6	10	7	6	7	6	5
Q01	Efficient elevator	C406.2.7.1	3	3	4	3	4	4	4	4	5	3	4	4	3	4	4	3	3	3	2
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	3	2	2	2	2	2	2	2	1	2	2	1	2	2	2	3	2	3	4

[a] "x" indicates credit is not available for that measure

Table C406.2(7) Base Energy Credits for Group E Occupancies [a]

ID	Energy Credit Measure	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	9	22	8	20	9	12	5	11	3	4	9	2	3	6	0	4	3	4	3
E03	Envelope leakage reduction	C406.2.1.3	4	3	3	3	2	5	2	1	1	1	1	1	1	1	1	2	1	1	1
E04	Add Roof Insulation	C406.2.1.4	8	8	4	9	5	7	16	7	1	14	7	10	18	13	13	23	25	22	28
E05	Add Wall Insulation	C406.2.1.5	5	7	4	8	3	6	8	6	2	6	3	6	5	5	6	7	6	7	8
E06	Improve Fenestration	C406.2.1.6	8	10	6	9	11	11	15	9	1	16	8	15	22	18	19	33	29	19	18
H01	HVAC Performance	C406.2.2.1	30	28	25	26	23	21	20	18	15	19	18	17	19	20	15	23	20	25	29
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	4	3	3	5	5	10	9	11	6	15	11	18	26
H03	Cooling efficiency	C406.2.2.3	9	8	6	7	5	4	2	2	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	45	42	37	41	36	34	41	39	30	43	46	58	57	65	40	79	63	88	117
W01	SHW preheat recovery	C406.2.3.1 a	7	7	9	8	10	11	13	13	15	14	15	15	15	14	17	13	15	14	12
W02	Heat pump water heater	C406.2.3.1 b	4	4	6	5	7	7	9	9	10	10	10	11	11	10	12	10	11	10	9
W03	Efficient gas water heater	C406.2.3.1 c	4	4	6	5	6	7	8	8	9	9	9	10	9	9	11	8	10	9	7
W04	SHW pipe insulation	C406.2.3.2	3	3	4	4	4	4	4	5	6	5	5	6	5	5	7	4	5	4	4
W05	Point of use water heaters	C406.2.3.3 a	3	4	4	4	4	5	5	5	6	5	5	5	5	5	6	4	5	4	3
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	1	2	1	1
W07	SHW heat trace system	C406.2.3.3 c	4	4	4	4	5	5	5	6	7	6	6	7	6	6	8	5	7	5	5
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	2	2	2	2	3	3	3	3	4	3	3	4	3	3	4	3	3	3	3
P01	Energy monitoring	C406.2.4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	5	6	6	6	5	6	7	6	6	6	5	5	6	4	4	3	2
L03	Increase occp. sensor	C406.2.5.3	4	4	5	5	5	6	6	6	7	6	6	5	4	4	5	3	4	3	2
L04	Increase daylight area	C406.2.5.4	6	6	7	7	7	7	7	7	8	6	6	6	5	5	6	5	5	5	4
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	6	7	7	7	8	8	8	8	10	7	8	7	6	7	8	5	6	4	2
Q01	Efficient elevator	C406.2.7.1	3	4	4	4	4	5	5	5	5	5	5	5	5	5	5	4	5	4	3
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q04	Fault detection	C406.2.7.4	4	4	4	4	3	3	3	3	2	3	3	3	3	3	2	4	3	4	4

[a]. "x" indicates credit is not available for that measure

Table C406.2(8) Base Energy Credits for Group S-1 and S-2 Occupancies [a]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	1	2	1	1	1	2	25	2	1	62	11	14	74	21	6	75	57	56	21
E03	Envelope leakage reduction	C406.2.1.3	2	2	1	2	1	3	31	3	1	77	14	17	92	25	8	95	71	69	26
E04	Add Roof Insulation	C406.2.1.4	13	12	10	11	10	11	18	17	7	14	19	18	14	20	22	10	14	12	19
E05	Add Wall Insulation	C406.2.1.5	19	23	13	21	7	10	15	12	3	10	12	13	9	12	12	7	9	9	8
E06	Improve Fenestration	C406.2.1.6	7	5	8	7	6	6	2	4	2	4	1	6	5	1	7	3	4	4	7
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	16	3	1	33	17	22	41	31	21	44	38	43	43
H03	Cooling efficiency	C406.2.2.3	7	7	4	5	3	3	1	1	1	1	1	1	1	1	1	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	35	37	26	33	24	27	77	35	14	141	83	96	168	132	90	180	157	177	178
W01	SHW preheat recovery	C406.2.3.1 a	8	7	9	8	10	10	8	10	12	5	8	8	4	6	9	3	4	3	3
W02	Heat pump water heater	C406.2.3.1 b	2	2	2	2	2	2	2	2	3	1	2	2	1	2	2	1	1	1	1
W03	Efficient gas water heater	C406.2.3.1 c	4	4	5	4	5	5	4	5	6	3	4	4	2	3	5	2	2	2	2
W04	SHW pipe insulation	C406.2.3.2	3	3	4	3	3	3	2	3	4	2	2	3	1	2	3	1	1	1	1
W05	Point of use water heaters	C406.2.3.3 a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	4	4	4	3	4	4	3	4	5	2	3	3	2	2	4	2	2	2	2
W08	SHW submeters	C406.2.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W09	SHW flow reduction	C406.2.3.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W10	Shower heat recovery	C406.2.3.6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
P01	Energy monitoring	C406.2.4	5	5	6	6	6	6	5	6	6	5	5	5	5	5	6	5	5	5	5
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	10	10	12	11	12	14	9	12	14	6	9	9	3	6	9	3	5	3	2
L03	Increase occp. sensor	C406.2.5.3	12	12	14	13	15	14	12	14	17	7	11	11	5	7	11	4	6	3	3
L04	Increase daylight area	C406.2.5.4	15	14	18	16	18	17	13	16	21	7	12	11	5	8	10	4	6	6	5
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	14	14	17	16	17	17	13	17	19	8	13	12	5	8	12	4	6	4	2
Q01	Efficient elevator	C406.2.7.1	15	14	18	16	18	18	15	18	21	9	14	14	7	10	14	5	7	5	5
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Q04	Fault detection	C406.2.7.4	3	3	2	3	2	2	3	2	1	5	3	3	5	4	3	6	5	6	6

a. “x” indicates measure credit is not available for that measure building occupancy in that climate zone

Table C406.2(9) Base Energy Credits for Other Occupancies [a, b]

ID	Energy Credit Measure	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
E01	Envelope Performance	C406.2.1.1	Determined in accordance with Section C406.2.1.1																		
E02	UA reduction (15%)	C406.2.1.2	5	9	5	8	5	6	10	5	2	20	6	6	25	10	4	28	22	26	16
E03	Envelope leakage reduction	C406.2.1.3	6	4	5	4	3	7	12	3	2	28	5	6	36	9	3	41	27	33	15
E04	Add Roof Insulation	C406.2.1.4	4	4	3	4	4	4	8	6	2	7	6	7	9	8	9	9	10	9	12
E05	Add Wall Insulation	C406.2.1.5	16	19	11	17	5	6	10	7	2	9	6	8	9	7	7	9	9	10	8
E06	Improve Fenestration	C406.2.1.6	4	4	3	4	5	6	6	4	1	9	4	7	11	7	6	16	14	8	8
H01	HVAC Performance	C406.2.2.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	6	2	3	11	6	8	15	11	9	18	15	19	23
H03	Cooling efficiency	C406.2.2.3	7	7	5	5	4	3	1	2	1	x	x	x	x	x	x	x	x	x	x
H04	Residential HVAC control	C406.2.2.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
H05	DOAS/fan control	C406.2.2.5	37	36	31	34	30	28	43	32	23	61	42	49	75	61	49	90	77	93	90
W01	SHW preheat recovery	C406.2.3.1 a	18	19	22	21	25	26	28	29	34	29	31	34	29	31	35	26	29	27	26
W02	Heat pump water heater	C406.2.3.1 b	12	12	15	14	17	17	20	20	24	21	22	25	21	23	26	20	22	21	20
W03	Efficient gas water heater	C406.2.3.1 c	11	11	13	13	15	16	17	17	21	18	19	21	18	19	22	16	18	17	16
W04	SHW pipe insulation	C406.2.3.2	3	3	4	4	4	4	4	4	5	4	4	5	4	4	5	3	4	3	3
W05	Point of use water heaters	C406.2.3.3 a	8	10	11	10	11	12	12	12	14	13	13	14	13	13	14	11	12	12	11
W06	Thermostatic bal. valves	C406.2.3.3 b	1	1	1	1	1	1	1	1	2	1	1	2	1	1	2	1	1	1	1
W07	SHW heat trace system	C406.2.3.3 c	5	5	5	5	6	6	6	6	7	6	6	7	5	6	7	5	5	5	5
W08	SHW submeters	C406.2.3.4	11	11	13	13	15	16	18	18	22	19	20	22	19	20	24	17	20	18	18
W09	SHW flow reduction	C406.2.3.5	29	30	36	35	41	43	48	48	56	50	53	59	51	54	62	47	52	49	48
W10	Shower heat recovery	C406.2.3.6	6	6	7	7	8	9	10	10	11	10	11	12	10	11	12	10	11	10	10
P01	Energy monitoring	C406.2.4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	4
L01	Lighting Performance	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L02	Lighting dimming & tuning	C406.2.5.2	5	5	5	5	6	6	5	6	7	5	5	5	4	4	5	3	4	3	2
L03	Increase occp. sensor	C406.2.5.3	5	6	6	6	7	7	6	7	8	5	6	6	4	5	6	3	4	3	2
L04	Increase daylight area	C406.2.5.4	7	8	9	8	9	9	8	8	10	6	7	7	5	6	6	4	5	5	4
L05	Residential light control	C406.2.5.5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
L06	Light power reduction	C406.2.5.7	7	7	8	7	8	8	7	8	9	5	7	6	4	5	6	4	4	3	2
Q01	Efficient elevator	C406.2.7.1	4	4	5	4	5	5	5	5	6	4	5	5	4	4	5	3	4	3	3
Q02	Commercial kitchen equip.	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Q03	Residential kitchen equip.	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Q04	Fault detection	C406.2.7.4	3	3	3	3	3	2	3	2	2	3	3	2	3	3	2	4	3	4	4

[a]. "x" indicates credit is not available for that measure

[b]. Other occupancy groups include all Groups except for Groups A-2, B, E, I, M, and R.

C406.2.1 More Efficient Building Envelope.

A project shall achieve credits for improved envelope performance by complying with of one of the following measures:

1. Section C406.2.1.1: E01
2. Section C406.2.1.2: E02
3. Section C406.2.1.3: E03
4. Both EO2 and E03
5. Any combination of

   5.1 Section C406.2.1.3: E03

   5.2 Section C406.2.1.4: E04

   5.3 Section C406.2.1.5: E05

   5.4 Section C406.2.1.6: E06

C406.2.1.1 EO1 Improved envelope performance 90.1 Appendix C.

Building envelope measures shall be installed to improve the energy performance of the project. The achieved energy credits shall be determined using Equation 4-13.

$$EC_{env} = 1000 \times (EPF_B - EPF_P)/EPF_B \quad \text{(Equation 4-13)}$$

where:

EC_{ENV} = E01 energy credits

EPF_B= base envelope performance factor calculated in accordance with ASHRAE 90.1-Appendix C.

EPF_P = proposed envelope performance factor calculated in accordance with ASHRAE 90.1-Appendix C.

C406.2.1.2 E02 Total UA envelope reduction.

Energy credits shall be achieved where the total UA of the *building thermal envelope* as designed is not less than 15 percent below the total UA of the *building* thermal envelope in accordance with Section C402.1.5.

C406.2.1.3 E03 Reduced air leakage.

[Special note to consensus committee and language coordination staff: The language below replaces and is coordinated with changes to Section C406 voted AM by the Envelope committee for proposals CEPI-58 and CEPI-71. The stringency level is the same, although this section allows a gradation of credits rather than just one level of results.]

Energy credits shall be achieved where tested *building* air leakage is not less than 10 percent less than the maximum leakage permitted by Section C402.5.2 provided the *building* is tested in accordance with the applicable method in Section C402.5.2. Energy credits achieved for measure E03 shall be determined as follows:

$$EC_{E03} = EC_B \times EC_{adj} \quad \text{(Equation 4-14)}$$

where:

EC_{E03} = energy efficiency credits achieved for envelope leakage reduction

EC_B = C406.2.1.3 credits from Tables C406.2(1) through C406.2(9)

EC_{adj} = Ls / ECa

Ls = Leakage savings fraction: the lessor of [(Lr – Lm) / Lr] or 0.8

Lr = maximum leakage permitted for tested *buildings*, by occupancy group, in accordance with Section C402.5.2

Lm = Measured leakage in accordance with Section C402.5.2.1 or C402.5.2.2

ECa = Energy Credit alignment factor:

0.37 for whole *building* tests in accordance with Section C402.5.2.1 or

0.25 for dwelling and sleeping unit enclosure tests in accordance with Section C402.5.2.2

C406.2.1.4 E04 Add Roof Insulation.

Energy credits shall be achieved for insulation that is in addition to the required insulation in Table C402.1.3.
All roof areas in the project shall have additional R-10 continuous insulation included in the roof assembly. For attics this is permitted to be achieved with fill or batt insulation rated at R-10 that is continuous and not interrupted by ceiling or roof joists. Where interrupted by joists, the added insulation shall be not less than R-13. Alternatively, one-half of the base credits shall be achieved where the added R-value is one-half of the additional R-value required by this section.

C406.2.1.5 E05 Added Wall Insulation.

Energy credits shall be achieved for insulation applied to not less than 90 percent of all opaque wall area in the project that is in addition to the required insulation in Table C402.1.3.

Opaque walls shall have additional R-5 continuous insulation included in the wall assembly. Alternatively, one-half of the base credits shall be achieved where the added R-value is R-2.5.

C406.2.1.6 E06 Improve fenestration

Energy credits for one selected fenestration energy credit ID shall be achieved for improved energy characteristics of all vertical fenestration in the project meeting the requirements in one of the rows of Table C406.2.1.6. The area-weighted average U-factor and SHGC of all vertical fenestration shall be equal to or less than the value shown in the selected table row. The area-weighted average visible transmittance (VT) of all vertical fenestration shall be equal to or greater than the value shown in the selected table row.

Table C406.2.1.6 Vertical Fenestration Requirements for Energy Credit E06

Applicable Climate Zones	Maximum U-Factor	Maximum SHGC	Minimum VT
0-2	0.45	0.21	0.28
3	0.31	0.23	0.30
4-5	0.29	0.34	0.41
6-7	0.26	0.38	0.44
8	0.24	0.38	0.44

C406.2.2 More Efficient HVAC Equipment Performance.

All heating and cooling systems shall meet the minimum requirements of Section C403 and efficiency improvements shall be referenced to minimum efficiencies listed in Tables referenced by Section C403.3.2. Where multiple efficiency requirements are listed, equipment shall meet the seasonal or part-load efficiencies including SEER, EER/integrated energy efficiency ratio (IEER), integrated part load value (IPLV), or AFUE. Equipment that is larger than the maximum capacity range indicated in Tables referenced by Section C403.3.2 shall utilize the values listed for the largest capacity equipment for the associated equipment type shown in the table. Where multiple individual heating or cooling systems serve the project, the improvement shall be the weighted average improvement based on individual system capacity.

Systems are permitted to achieve HVAC energy credits by meeting the requirements of either:

1. C406.2.2.1 H01
2. C406.2.2.2 H02
3. C406.2.2.3 H03
4. C406.2.2.4 H04
5. C406.2.2.5 H05
6. Any combination of H02, H03, H04 and H05
7. The combination of H01 and H04

[Special note to consensus committee and staff language coordination: The H01 modifications adapt TSPR, passed AM in CEPI-76 to align with revision of energy credits in CEPI-193. The updates include tabular values for H01 that have been adjusted to the new credit values. They match the intent of C406 provisions in CEPI-76 and supersede the C406 language in CEPI-76]

C406.2.2.1 H01 HVAC Performance (TSPR).

H01 energy credits shall be achieved for systems allowed to use Section C403.1.3, HVAC total system performance ratio, where the proposed TSPR exceeds the minimum TSPR requirement by 5 percent. If improvement is greater, base energy credits from Table C406.2(1) through C406.2(9) are permitted to be prorated up to a 20 percent improvement using Equation 4-15. Energy credits for H01 may not be combined with energy credits from HVAC measures H02, H03 and H05.

H01 energy credit = H01 base energy credit x TSPRs / 0.05 (Equation 4-15)

where:

TSPRs = the lessor of 0.20 and (1 – (TSPRp / TSPRt))

where:

TSPRt = TSPRr / MPF

TSPRp = HVAC TSPR of the proposed design calculated in accordance with Sections C409.4, C409.5 and C409.6.

TSPRr = HVAC TSPR of the reference building design calculated in accordance with Sections C409.4, C409.5 and C409.6.

MPF = Mechanical Performance Factor from Table C409.4 based on climate zone and building use type

Where a *building* has multiple building use types, MPF shall be area weighted in accordance with Section C409.4

C406.2.2.2 H02 More efficient HVAC equipment heating performance.

No less than 90 percent of the total HVAC capacity serving the total *conditioned floor area* of the entire *building*, or tenant space in accordance with Section C406.1.1, shall comply with the requirements of this Section.

1. Equipment installed shall be types that are listed in Tables referenced by Section C403.3.2. Electric resistance heating capacity shall be limited to 20 percent of system capacity, with the exception of heat pump supplemental heating.
2. Equipment shall exceed the minimum heating efficiency requirements listed in Tables referenced by Section C403.3.2 by at least 5 percent. Where equipment exceeds the minimum annual heating efficiency requirements by more than 5 percent, energy efficiency credits for heating shall be determined using Equation 4-16 rounded to the nearest whole number.

$$EEC_{HEH} = EEC_{H5} \times (HEI / 0.05) \quad \text{(Equation 4-16)}$$

where:

EEC_{HEH} = energy efficiency credits for heating efficiency improvement

EEC_{H5} = C406.2.2.2 credits from Tables C406.2(1) through C406.2(9)

HEI = the lesser of: the improvement (as a fraction) above minimum heating efficiency requirements, or 20 percent(0.20). Where heating equipment with different minimum efficiencies are included in the *building*, a heating capacity weighted average improvement shall be used. Where electric resistance primary heating or reheat is included in the *building* it shall be included in the weighted average improvement with an HEI of 0. Supplemental gas and electric heat for heat pump systems shall be excluded from the weighted HEI. For heat pumps rated at multiple ambient temperatures, the efficiency at 47°F (8.3°C) shall be used.

For metrics that increase as efficiency increases, HEI shall be calculated as follows:

$$HEI = \frac{HM_{DES}}{HM_{MIN}} - 1$$

Where:

HM_{DES} = Design heating efficiency metric, part-load or annualized where available

HM_{MIN} = Minimum required heating efficiency metric, part-load or annualized where available from Section C403.3.2

Exception: In low energy spaces complying with Section C402.1.1, where no less than 90 percent of the installed heating capacity is provided by electric infrared or gas-fired radiant heating equipment for localized heating applications. Such spaces shall only achieve energy credits for EEC_5.

C406.2.2.3 H03 More efficient HVAC cooling equipment and fan performance.

No less than 90 percent of the total HVAC cooling capacity serving the total *conditioned floor area* of the entire *building* or tenant space in accordance with Section C406.1.1, shall comply with all of the requirements of this section.

1. Equipment installed shall be types that are listed in Tables referenced by Section C403.3.2.
2. Equipment shall exceed the minimum cooling efficiency requirements listed in Tables referenced by Section C403.3.2 by at least 5 percent. For water-cooled chiller plants, heat rejection equipment *efficiency* shall also be increased by at least the chiller efficiency improvement. Where equipment exceeds the minimum annual cooling efficiency and heat rejection efficiency requirements by more than 5 percent, energy efficiency credits for cooling shall be determined using Equation 4-17, rounded to the nearest whole number.
3. Where fan energy is not included in packaged equipment rating or it is and the fan size has been increased from the as-rated equipment condition, fan power or horsepower shall be less than 95 percent of the allowed fan power in Section C403.8.1.

$EEC_{HEC} = EEC_5 \times (CEI / 0.05)$ (Equation 4-17)

where:

EEC_{HEC} = energy efficiency credits for cooling efficiency improvement

EEC_5 = C406.2.2.3 base energy credits from Tables C406.2(1) through C406.2(9)

CEI = the lesser of: the improvement above minimum cooling and heat rejection efficiency requirements expressed as a fraction, or 0.20 (20 percent). Where cooling equipment with different minimum efficiencies are included in the *building*, a cooling capacity weighted average improvement shall be used. Where multiple cooling performance requirements are provided, the *equipment* shall exceed the annualized energy or part-load requirement. Meeting both part-load and full-load efficiencies is not required.

For metrics that increase as efficiency increases, CEI shall be calculated as follows:

$$CEI = \frac{CM_{DES}}{CM_{MIN}} - 1$$

For metrics that decrease as efficiency increases, CEI shall be calculated as follows:

$$CEI = \frac{CM_{MIN}}{CM_{DES}} - 1$$

Where:

CM_{DES} = Design cooling efficiency metric, part-load or annualized where available

CM_{MIN} = Minimum required cooling efficiency metric, part-load or annualized where available from Section C403.3.2

For Data Centers using Standard 90.4, CEI shall be calculated as follows:

$$CEI = \frac{AMLC_{MAX}}{AMLC_{DES}} - 1$$

Where:

$AMLC_{DES}$ = As-Designed Annualized Mechanical Load Component calculated in accordance with Standard 90.4, Section 6.5

$AMLC_{MAX}$ = Maximum Annualized Mechanical Load Component from Standard 90.4, Table 6.5

C406.2.2.4 H04 Residential HVAC control.

HVAC systems serving *dwelling units* or *sleeping units* shall be controlled to automatically activate a setback at least 5°F (3°C) for both heating and cooling. The temperature controller shall be configured to provide setback during occupied sleep periods. The unoccupied setback mode shall be configured to operate in conjunction with one of the following:

1. A manual main control device by each *dwelling unit* main entrance that initiates setback and non-ventilation mode for all HVAC units in the dwelling unit and is clearly identified as "Heating/Cooling Master Setback."
2. Occupancy sensors in each room of the *dwelling unit* combined with a door switch to initiate setback and non-ventilation mode for all HVAC units in the dwelling within 20 minutes of all spaces being vacant immediately after a door switch operation. Where separate room HVAC units are used, an individual occupancy sensor on each unit that is configured to provide setback shall meet this requirement.
3. An advanced learning thermostat or controller that recognizes occupant presence and automatically creates a schedule for occupancy and provides a dynamic setback schedule based on when the spaces are generally unoccupied.
4. An automated control and sensing system that uses geographic fencing connected to the dwelling unit occupants' cell phones and initiates the setback condition when all occupants are away from the *building*.

C406.2.2.5 H05 Dedicated Outdoor Air System.

Credits for this measure are only allowed where single zone HVAC units are not required to have multi-speed or variable-speed fan control in accordance with Section C403.8.6.1. HVAC controls and *ventilation* systems shall include all of the following:

1. Zone controls shall cycle the heating/cooling unit fans off when not providing required heating and cooling or shall limit fan power to 0.12 watts/cfm of zone outdoor air.
2. Outdoor air shall be supplied by an independent ventilation system designed to provide no more than 110

percent of the minimum outdoor air to each individual occupied zone, as specified by the *International Mechanical Code.*

3. The ventilation system shall have energy recovery with an *enthalpy recovery ratio* of 65 percent or more at heating design conditions in climate zones 3 through 8 and an enthalpy recovery ratio of 65 percent or more at cooling design conditions in climate zones 0, 1, 2, 3A, 3B, 4A, 4B, 5A, and 6A. In "A" climate zones, energy recovery shall include latent recovery. Where no humidification is provided, heating energy recovery effectiveness is permitted to be based on *sensible energy recovery ratio*. Where energy recovery effectiveness is less than the 65 percent required for full credit, adjust the credits from Section C406.2 by the factors in Table C406.2.2.5.
4. Where the ventilation system serves multiple zones and the system is not in a latent recovery outside air dehumidification mode. partial economizer cooling through an outdoor air bypass or wheel speed control shall automatically do one of the following:
   4.1. Set the energy recovery leaving-air temperature 55°F (13°C) or 100 percent outdoor air bypass when a majority of zones require cooling and outdoor air temperature is below 70°F (21°C).
   4.2. The HVAC ventilation system shall include supply-air temperature controls that automatically reset the supply-air temperature in response to representative *building* loads, or to outdoor air temperatures. The controls shall reset the supply-air temperature not less than 25 percent of the difference between the design supply-air temperature and the design room-air temperature.
5. Ventilation systems providing mechanical dehumidification shall use recovered energy for reheat within the limits of item 4. This shall not limit the use of latent energy recovery for dehumidification.

Where only a portion of the *building* is permitted to be served by constant air volume units or the *enthalpy recovery ratio* or *sensible energy recovery ratio* is less than 65 percent, the base energy credits shown in Section C406.2 shall be prorated as follows:

$$\mathrm{EC_{DOAS}} = \mathrm{EC_{base}} \times \mathrm{FLOOR}_{CAV} \times \mathrm{ERE}_{adj} \qquad \text{(Equation 4-18)}$$

where:

$\mathrm{EC_{DOAS}}$ = Energy credits achieved for H06

$\mathrm{EC_{base}}$ = H06 base energy credits in Section C406.2

$\mathrm{Floor_{CAV}}$ = Fraction of whole project *gross conditioned floor area* not required to have variable speed or multi-speed fan airflow control in accordance with Section C403.8.6.

$\mathrm{ERE_{adj}}$ = The energy recovery adjustment from Table C406.2.2.5 based on the lower of actual cooling or heating *enthalpy recovery ratio* or *sensible energy recovery ratio* where required for the climate zone. Where recovery ratios vary, use a weighted average by supply airflow.

Table C406.2.2.5 – DOAS Energy Recovery Adjustments

ERE_{adj} based on lower of actual heating or cooling energy recovery effectiveness where required		
Cooling ERR is ≥	Heating *enthalpy recovery ratio* or *sensible energy recovery ratio* is ≥	Energy Recovery Effectiveness Adjustment (ERE_{adj})
65%	65%	1.00
60%	60%	0.67
55%	55% [a]	0.33
50%	50% [a]	0.25

[a]In climate zones where heating recovery is required for this measure, for dwelling units a heating recovery effectiveness below 60 percent is not allowed.

C406.2.3 Reduced Energy Use In-service Water Heating.

Projects with service water-heating equipment that serves the whole *building*, a *building* addition or a tenant space shall achieve credits through compliance with the requirements of this section. Systems are permitted to achieve energy credits by meeting the requirements of either:

1. C406.2.3.1 by selecting one allowed measure W01, W02 or W03
2. C406.2.3.2 W04
3. C406.2.3.3 by selecting one allowed measure of W05, W06, or W07
4. C406.2.3.4 W08
5. C406.2.3.5 W09
6. C406.2.3.6 W10
7. Any combination of measures in C402.2.3.1 through C402.2.3.6 as long no more than one allowed measure from C406.2.3.1 and C406.2.3.3 are selected.

C406.2.3.1 Service water-heating system efficiency.

A project is allowed to achieve energy credits from only one of Sections C406.2.3.1.1 through C406.2.3.1.4.

C406.2.3.1.1 W01 Recovered or renewable water heating. The *building* service water-heating system shall have one or more of the following that are sized to provide not less than 30 percent of the *building's* annual hot water requirements, or sized to provide not less than 70 percent of the *building's* annual hot water requirements if the *building* is required to comply with Section C403.10.5:

1. Waste heat recovery from SHW, heat recovery chillers, *building* equipment, or process equipment.
2. A water-to-water heat pump that precools chilled water return for *building* cooling.
3. On-site renewable energy water-heating systems.

C406.2.3.1.2 W02 Heat pump water heater. Air-source heat pump *water heater*s shall be installed according to manufacturer's instructions and at least 30 percent of design end use service water heating requirements shall be met using only heat pump heating at an ambient condition of 67.5°F, db without supplemental electric resistance or fossil fuel heating. For a heat pump water heater with supplemental electric resistance heating, the heat pump only capacity shall be deemed at 40 percent of first hour draw. Where the heat pump only capacity exceeds 50 percent of the design end use load excluding *recirculating* system losses, the credits from the Section C406.2 tables shall be prorated as follows:

$$EC_{\mathrm{HPWH}} = \frac{\mathrm{EC_{base}}}{0.5} \times \left\{\frac{\mathrm{Cap_{HPWH}}}{\mathrm{EndLoad}} \ [not\ greater\ than\ 2]\right\} \quad \text{(Equation 4-19)}$$

where:

EC_{HPWH} = Energy credits achieved for W02

EC_{base} = W02 base energy credits Section 13.5.3

EndLoad = End use peak hot water load, excluding load for heat trace or recirculation, Btu/hr or kW

Cap_{HPWH} = the heat pump only capacity at 50°F (10°C) entering air and 70°F (21°C) entering potable water without supplemental electric resistance or fossil fuel heat, Btu/hr or kW

The heat pump service water heating system shall comply with the following requirements:

1. For systems with an installed total output capacity of more than 100,000 Btu/hr (30 kW) at an ambient condition of 67.5°F (19.7°C), db a preheat storage tank with greater than or equal 0.75 gallons per 1000 Btu/hr (≥9.7 L/kW) of design end use *service water heating* requirements shall be heated only with heat pump heating when the ambient temperature is greater than 45°F (7.2°C)
2. For systems with piping temperature maintenance, either a heat trace system or a separate *water heater* in series for recirculating system and final heating shall be installed.
3. Heat pump *water heater* efficiency shall meet or exceed one of the following:
   3.1. Output-capacity-weighted-average UEF of 3.0 in accordance with 10 CFR 430 Appendix E.
   3.2. Output-capacity-weighted-average COP of not less than 4.0 tested at 50°F (10°C) entering air and 70°F (21°C) entering potable water in accordance with AHRI standard 1300.

Where the heat pump capacity at 50°F (10°C) entering air and 70°F (21°C) entering water exceeds 50 percent of the design end-use load excluding recirculating system losses, the base credits from Section C406.2 shall be prorated based on Equation 4-20.

W02 credit = base W02 table credit × (HP_{LF} / 50%) (Equation 4-20)

where:

HP_{LF} = Heat pump capacity as a fraction of the design end-use SHW requirements excluding recirculating system losses, not to exceed 80 percent.

C406.2.3.1.3 W03 Efficient fossil fuel water heater. The combined input-capacity-weighted-average equipment rating of all gas water-heating equipment in the *building* shall be not less than 95 percent Et or 0.93 UEF. This measure shall receive only thirty percent of the listed energy credits for *buildings* required to comply with C404.2.1. Projects where the installed *building* service water heating capacity is less than 200,000 Btu/hr (59 kW) and weighted UEF is not less than 0.82 shall achieve 25 percent of the base table W03 credit.

C406.2.3.1.4 Combination service water heating systems shall achieve credits using one of the measure combinations as follows:

1. (W01 + W02) Where service water heating employs both energy recovery and heat pump water heating, W01 may be combined with W02 and receive the sum of both credits.
2. (W01 + W03) Where service water heating employs both energy recovery and efficient gas water heating, W01 may be combined with W03 and receive the sum of the W01 credit and the portion of the W03 credit based on item 4.
3. (W02 + W03) Where service water heating employs both heat pump water heating and efficient gas water heating, W02 may be combined with W03 and receive the sum of the W02 credit and the portion of the W03 credit based on item 4.

For items 2 and 3, the achieved W03 credit shall be the Section C406.2.3.1.3 W03 credit multiplied by the fractional share of total water heating installed capacity served by gas water heating that is not less than 95 percent Et or 0.93 UEF. In no case shall the achieved W03 credit exceed 60 percent of the W03 credit in Section C406.2 tables. In *Buildings* that have a service water heating design generating capacity greater than 900,000 Btu/h that proportioned W03 credit shall be further multiplied by 30 percent.

C406.2.3.3 Water-heating distribution temperature maintenance.

A project is allowed to achieve energy credits from only one of the following SHW distribution temperature maintenance measures.

W04: Service Hot Water Piping Insulation Increase. Where service hot water is provided by a central water heating system, the hot water pipe insulation thickness shall be at least 1.5 times the thickness required in Section C404.4. All service hot water piping shall be insulated from the hot water source to the fixture shutoff. Where no more than 50% of hot water piping does not have increased insulation due to installation in partitions, the credit shall be prorated as a percentage of lineal feet of piping with increased insulation.

W05 Point of use water heaters. Credits are available for Group B or E buildings larger than 10,000 ft^2 (930 m^2). Fixtures requiring hot water shall be supplied from a localized source of hot water with no recirculating system or heat trace piping. Supply piping from the water heater to the termination of the fixture supply pipe shall be insulated to the levels shown in Table C403.12.3 without exception. The volume from the water heater to the termination of the fixture supply pipe shall be limited as follows:

1. Non-residential lavatories: not more than 2 oz (60 mL)
2. All other plumbing fixtures or appliances: not more than 0.25 gallons (0.95 L)

Exception: Where all remotely located hot water uses meet the requirements for measure W05, separate water heaters serving commercial kitchens or showers in locker rooms shall be permitted to have a local recirculating system or heat trace piping.

W06 Thermostatic balancing valves. Credits are available where service water heating is provided centrally and distributed throughout the *building* and has a recirculating system. Each recirculating system branch return connection to the main SHW supply piping shall have an automatic thermostatic balancing valve set to a minimal return water flow when the branch return temperature is greater than 120°F (49°C).

W07 Heat trace system. Credits are available for projects with gross floor area greater than 10,000 square feet (930 m^2) and a central water-heating system. The energy credits achieved shall be from Tables C406.2(1) through C406.2(9). This system shall include self-regulating electric heat cables, connection kits, and electronic controls. The cable shall be installed directly on the hot water supply pipes underneath the insulation to replace standby losses.

C406.2.3.4 W08 Water-heating system submeters.

Each individual *dwelling unit* in a Group R-2 occupancy served by a central service water-heating system shall be provided with a service hot water meter connected to a reporting system that provides individual *dwelling unit* reporting of actual domestic hot water use. Preheated water serving the cold water inlet to showers need not be metered.

C406.2.3.5 W09 Service hot water flow reduction.

Dwelling unit, sleeping unit, and guest room plumbing fixtures that are connected to the service water-heating system shall have a flow or consumption rating less than or equal to the values shown in Table C406.2.3.5.

Table C406.2.3.5
Maximum Flow Rating for Residential Plumbing Fixtures with Heated Water

Plumbing Fixture	Maximum Flow Rate
Faucet for private lavatory,[a] hand sinks, or bar sinks	1.50 gpm at 60 psi (0.095 L/s at 410 kPa)
Faucet for residential kitchen sink [a,b, c]	1.8 gpm at 60 psi 0.11 L/s at 410 kPa)
Shower head (including hand-held shower spray) [a, b, d]	2.0 gpm at 80 psi (0.13 L/s at 550 kPa)

a. Showerheads, lavatory faucets and kitchen faucets are subject to U.S. Federal requirements listed in 10 CFR 430.32(o)- (p).

b. Maximum flow allowed is less than required by flow rates listed in U.S. 10 CFR 430.32(o)-(p) for showerheads and kitchen faucets.
c. Residential kitchen faucet may temporarily increase the flow above the maximum rate, but not above 2.2 gallons per minute at 60 psi (0.14 L/s at 410 kPa) and must default to the maximum flow rate listed.
d. When a shower is served by multiple shower heads, the combined flow rate of all shower heads controlled by a single valve shall not exceed the maximum flow rate listed or the shower shall be designed to allow only one shower head to operate at a time.

C406.2.3.6 W10 Shower drain heat recovery.

Cold water serving *building* showers shall be preheated by shower drain heat recovery units that comply with Section C404.7. The efficiency of drain heat recovery units shall be 54 percent or greater measured in accordance with CSA B55.1. Full credits are applicable to the following *building* uses: I-2, I-4, R-1, R-2 and also group E where there are more than eight showers. Partial credits are applicable to *buildings* where all but ground floor showers are served where the base energy credit from Section C406.2 is adjusted by Equation 4-21.

$$\textbf{W10 credit} = \textbf{W10 base energy credit} \times \frac{\textbf{showers with drain heat recovery}}{\textbf{total showers in } \textit{building}} \quad \text{(Equation 4-21)}$$

C406.2.4 P01 Energy Monitoring.

A project not required to comply with C405.12 can achieve energy credits for installing an energy monitoring system that complies with all the requirements of C405.12.1 through C405.12.5.

C406.2.5 Energy Savings in Lighting Systems.

Projects are permitted to achieve energy credits for increased lighting system performance by meeting the requirements of either:

1. C406.2.5.2 L02
2. C406.2.5.3 L03
3. C406.2.5.4 L04
4. C406.2.5.5 L05
5. C406.2.5.6 L06
6. Any combination of L03, L04, L05 and L06
7. Any combination of L02, L03 and L04

Where lighting energy credit measures include reductions in lighting power, the lighting shall achieve ANSI/IES recommended practice for minimum illuminance levels as referenced at "The Interactive Illuminance Selector," which includes minimum recommended illuminance levels from various ANSI/IES RP-## standards.

C406.2.5.1 L01 Lighting system performance (reserved).

Reserved for future use

C406.2.5.2 L02 Enhanced digital lighting controls.

Measure credits shall be achieved where no less than 50 percent of the gross floor area within the project shall comply with the requirements of this section.

1. Lighting controls function. Interior general lighting shall be located, scheduled and operated in accordance with Section C405.2 and shall be configured with the following enhanced control functions:
   1.1. Luminaires shall be configured for continuous dimming.
   1.2. Each luminaire shall be individually addressed.
   Exceptions:
   1. Multiple luminaires mounted on no more than 12 linear feet of a single lighting track and addressed as a single

luminaire.

2. Multiple linear luminaires that are ganged together to create the appearance of a single longer fixture and addressed as a single luminaire, where the total length of the combined luminaires is not more than 12 feet.

1.3. No more than eight luminaires within a *daylight zone* are permitted to be controlled by a single *daylight responsive control*.

2. Luminaires shall be controlled by a digital control system configured with the following capabilities:
   2.1. Scheduling and illumination levels of individual luminaires and groups of luminaires are capable of being reconfigured through the system.
   2.2. Load shedding.
   2.3. Occupancy sensors and daylight responsive controls are capable of being reconfigured through the system.
3. Construction documents shall include submittal of a Sequence of Operations, including a specification outlining each of the functions required by this section.
4. High-end trim. Luminaires shall be initially configured with the following:
   4.1. High-end trim, setting the maximum light output of individual luminaires or groups of luminaires to support visual needs of a space or area, shall be implemented and construction documents shall state that maximum light output or power of controlled lighting shall be initially reduced by at least 15 percent from full output. The average maximum light output or power of the controlled lighting shall be documented without high-end trim and with high-end trim to verify reduction of light output or power by at least 15 percent when tuned.
   4.2. Where lumen maintenance control is used, controls shall be configured to limit the initial maximum lumen output or maximum lighting power to 85 percent or less of full light output or full power draw and lumen maintenance controls shall be limited to increasing lighting power by 1 percent per year.
   4.3. High-end trim and lumen maintenance controls shall be accessible only to authorized personnel.

Where *general lighting* in more than 50 percent of the *gross lighted floor area* receives *high-end trim*, the base credits from Section C406.2 shall be prorated as follows:

[Tuned lighted floor area,%] × [Base energy credits for C406.2.5.2] / 50% (Equation 4-22)

C406.2.5.3 L03 Increase occupancy sensor.

Lighting controls shall comply with C406.2.5.3.1, C406.2.5.3.2 and C406.2.5.3.3.

C406.2.5.3.1 Occupant Sensor Controls. *Occupant sensor controls* shall be installed to control lights in the following space types:

1. Courtroom
2. Electrical / mechanical room
3. Food preparation area
4. Laboratory
5. Elevator lobby
6. Pharmacy Area
7. Vehicular Maintenance Area
8. Workshop
9. Chapel in a facility for the visually impaired
10. Recreation room in a facility for the visually impaired
11. Exercise area in a fitness center
12. Playing area in a fitness center
13. Exam / treatment room in a healthcare facility
14. Imaging room in a healthcare facility
15. Physical therapy room in a healthcare facility
16. Library reading area
17. Library stacks
18. Detailed manufacturing area
19. Equipment room in a manufacturing facility

20. Low-bay area in a manufacturing facility
21. Post office sorting area
22. Religious fellowship hall
23. Religious worship / pulpit / choir area
24. Hair salon
25. Nail salon

Note to staff coordinating proposal text: If the following areas are added to C405.2.1 with another proposal, they can be deleted here.

26. Banking activity area
27. Computer room, data center
28. Laundry / washing area
29. Medical supply room in a healthcare facility
30. Telemedicine room in a healthcare facility
31. Museum restoration room

C406.2.5.3.2 Occupant Sensor Control Function.

Occupant sensor controls shall automatically turn lights off within 10 minutes after all occupants have left the space. A manual control complying with C405.2.6 shall allow occupants to turn off lights. *Time-switch controls* are not required.

Exception: In spaces where an automatic shutoff could endanger occupant safety or security *occupant sensor controls* shall uniformly reduce lighting power to not more than 20 percent of full power within 10 minutes after all occupants have left the space. *Time-switch controls* complying with C405.2.2.1 shall automatically turn lights off.

C406.2.5.3.3 Occupant Sensor Time Function.

Occupant sensor controls installed in accordance with Sections C405.2.1.1, C405.2.1.2, C405.2.1.3, and C405.2.1.4 shall automatically turn lights off or reduce lighting power within 10 minutes after all occupants have left the space. Where lighting power is reduced, the unoccupied setpoint shall be 20 percent of full power or in egress areas to the power level required to meet egress light levels.

C406.2.5.4 L04 Increase daylight area.

The total daylight area of the project (DLA_{BLDG}) with continuous daylight dimming meeting the requirements of C405.2.4 shall be at least 5 percent greater than the typical daylit area (DLA_{TYP}).

Credits for measure L04 shall be determined based on Equation 4-23:

$$EC_{DL} = EC_{DL5} \times 20 \times [(DLA_{BLDG}/GLFA) - DLA_{TYP}] \quad \text{(Equation 4-23)}$$

where:

EC_{DL} = C406.2.5.4 L04 measure base energy credits

DLA_{BLDG} = The lesser of actual area of *daylight zones* in the *building* with continuous daylight dimming, ft^2 or m^2 and (GLFA x DLA_{max}) see Table C406.2.5.4. *Daylight zones* shall meet the criteria in Sections C405.2.4.2 and C405.2.4.3 for primary sidelit *daylight zones*, secondary sidelit *daylight zones*, and toplit *daylight zones*.

GLFA = Project gross lighted floor area, ft^2 or m^2

DLA_{TYP} = Typical percentage of *building* area with daylight control (as a fraction) from Table C406.2.5.4:

EC_{DL5} = C406.2.5.4 L04 base energy credits from Section C406.2

TABLE C406.2.5.4
ADDED DAYLIGHTING PARAMETERS

Building use type	DLA_{TYP}	DLA_{max}
Group B; Office ≤ 5000 ft^2 (460 m^2)	10%	20%
Group B; Office > 5000 ft^2 (460 m^2)	21%	31%
Group M; Retail with ≤ 1000 ft^2 (900 m^2) *roof* area	0%	20%
Group M; Retail with > 1000 ft^2 (900 m^2) *roof* area	60%	80%
Group E; Education	42%	52%
Groups S-1 and S-2; Warehouse	50%	70%
Group I-2, R, and other; Medical, hotel, multifamily, dormitory, and other	NA	NA

C406.2.5.5 L05 Residential light control.

In *buildings* with Group R-2 occupancy spaces, interior lighting systems shall comply with the following:

1. Common area Restrooms, laundry rooms, storage rooms, and utility rooms shall have automatic full OFF occupancy sensor controls that comply with the requirements of C405.2.1.1. Each additional control device shall control no more than 5,000 sq.ft.
2. Each *dwelling unit* shall have a main control by the main entrance that turns off all the lights and all switched receptacles in the *dwelling unit*. Two switched receptacles shall be provided in living and sleeping rooms or areas and clearly identified. All switched receptacles shall be located within 12 inches (30 cm) of an unswitched receptacle. The main control shall be permitted to have two controls, one for permanently wired lighting and one for switched receptacles. The main controls should be clearly identified as “lights master off” and “switched outlets master off.”

C406.2.5.6 L06 Reduced lighting power.

Interior lighting within the whole building shall comply with all the requirements of this section. The net connected interior lighting power (LPn) shall be 95 percent or less than the net interior lighting power allowance (LPAn) determined in accordance with Section C405.3.2.2. In R-1 and R-2 occupancies the credit is calculated for all common areas other than dwelling units and sleeping units. No less than 95 percent of the permanently installed light fixtures in *dwelling units* and *sleeping units,* excluding kitchen appliance lighting, shall be provided by high efficacy lamps with a minimum efficacy of 90 lumens per watt or high efficacy luminaires that have a minimum efficacy of 55 lumens per watt. Energy credits shall not be greater than four times the L06 base credit from Section C406.2 and shall be determined using Equation 4-24:

$$EC_{LPA} = EC_5 \times 20 \times (LPA_n - LP_n)/LPA_n \quad \text{(Equation 4-24)}$$

where:

EC_{LPA} = additional energy credit for lighting power reduction

LP_n = net connected interior lighting power calculated in accordance with SectionC405.3.1, watts, excluding any additional lighting power allowed in Section C405.3.2.2.1

LPA_n = interior lighting power allowance calculated in accordance with the requirements of Section C405.3.2.2, watts, less any additional interior lighting power allowed in Section C405.3.2.2.1

EC_5 = L06 base credit from Section C406.2

C406.2.7 Efficient Equipment Credits.

Projects are permitted to achieve energy credits using any combination of Efficient Equipment Credits Q01 through Q04.

C406.2.7.1 Q01 Efficient Elevator Equipment.

Qualifying elevators in the *building* shall be Energy efficiency class A per ISO 25745-2, Table 7. Only *buildings* 3 or more floors above grade are permitted to use this credit. Credits shall be prorated based on Equation 4-25, rounded to the nearest whole credit. Projects with a compliance ratio below 0.5 do not qualify for this credit.

$$EC_e = EC_t \times CR_e \qquad \text{(Equation 4-25)}$$

where:

EC_e = Elevator energy credit achieved for the *building*

ECt = C406.2.7.1 Table energy credit

CR_e = Compliance Ratio = (F_A / F_B)

F_A = Sum of floors served by class A elevators

F_B = Sum of floors served by all *building* elevators and escalators

C406.2.7.2 Q02 Efficient Commercial Kitchen Equipment.

For *buildings* and spaces designated as Group A-2, or facilities whose primary business type involves the use of a commercial kitchen where at least one gas or electric fryer is installed before the issuance of the Certificate of Occupancy all fryers, dishwashers, steam cookers and ovens installed before the issuance of the Certificate of Occupancy shall comply with all of the following:

1. Achieve performance levels in accordance with the equipment specifications listed in Tables C406.2.7.2 (1) through C406.2.7.2 (4) when rated in accordance with the applicable test procedure.
2. Have associated performance levels listed on the construction documents submitted for permitting.

Table C406.2.7.2(1)
Minimum Efficiency Requirements: Commercial Fryers

	Heavy-Load Cooking Energy Efficiency	Idle Energy Rate	Test Procedure
Standard Open Deep-Fat Gas Fryers	≥ 50%	≤ 9,000 Btu/hr (≤ 2,600 watts)	ASTM F1361
Standard Open Deep-Fat Electric Fryers	≥ 83%	≤ 800 watts	
Large Vat Open Deep-Fat Gas Fryers	≥ 50%	≤ 12,000 Btu/hr (≤ 3,500 watts)	ASTM F2144
Large Vat Open Deep-Fat Electric Fryers	≥ 80%	≤ 1,100 watts	

Table C406.2.7.2(2)
Minimum Efficiency Requirements: Commercial Steam Cookers

Fuel Type	Pan Capacity	Cooking Energy Efficiency[a]	Idle Energy Rate	Test Procedure
Electric Steam	3-pan	50%	400 W	ASTM F1484
	4-pan	50%	530 W	
	5-pan	50%	670 W	
	6-pan and larger	50%	800 W	
Gas Steam	3-pan	38%	6,250 Btu/h 1.83 kW	
	4-pan	38%	8,350 Btu/h 2.45 kW	
	5-pan	38%	10,400 Btu/h 3.05 kW	
	6-pan and larger	38%	12,500 Btu/h 3.66 kW	

TABLE C406.2.7.2(3)
MINIMUM EFFICIENCY REQUIREMENTS: COMMERCIAL DISHWASHERS

Machine Type	High Temperature Efficiency Requirements			Low Temperature Efficiency Requirements			Test Procedure
	Idle Energy Rate[a]	Washing Energy	Water Consumption[b]	Idle Energy Rate[a]	Washing Energy	Water Consumption[b]	
Under Counter	≤ 0.30 kW	≤ 0.35 kWh/rack	≤ 0.86 GPR (≤ 3.3 LPR)	≤ 0.25 kW	≤ 0.15 kWh/rack	≤ 1.19 GPR ≤ 4.5 LPR	ASTM F1696 ASTM F1920
Stationary Single Tank Door	≤ 0.55 kW	≤ 0.35 kWh/rack	≤ 0.89 GPR (≤ 3.4 LPR)	≤ 0.30 kW	≤ 0.15 kWh/rack	≤ 1.18 GPR ≤ 4.47 LPR	
Pot, Pan, and Utensil	≤ 0.90 kW	kWh/rack ≤ 0.55 + 0.05 × SF_{rack}[c] (≤ 0.55 + 0.0046 × SM_{rack}[c)]	≤ 0.58 GPSF (≤ 2.2 LPSM)	N/A	N/A	N/A	
Single Tank Conveyor	≤ 1.20 kW	≤ 0.36 kWh/rack	≤ 0.70 GPR (≤ 2.6 LPR_	≤ 9.85 kW	≤ 0.16 kWh/rack	≤ 0.79 GPR ≤ 3.0 LPR	
Multiple Tank Conveyor	≤ 1.85 kW	≤ 0.36 kWh/rack	≤ 0.54 GPR (≤ 2.0 LPR)	≤ 1.00 kW	≤ 0.22 kWh/rack	≤ 0.54 GPR ≤ 2.0 LPR	
Single Tank Flight Type	Reported	Reported	GPH ≤ 2.975c + 55.0 (LPH ≤ 0.276d + 208)	N/A	N/A	N/A	
Multiple Tank Flight Type	Reported	Reported	GPH ≤ 4.96c + 17.00 (LPH ≤ 0.461d + 787)	N/A		N/A	

a. Idle results should be measured with the door closed and represent the total idle energy consumed by the machine including all tank heaters and controls. The most energy consumptive configuration in the product family shall be selected to test the idle energy rate. Booster heater (internal or external) energy consumption shall be measured and reported separately, if possible, per ASTM F1696 and ASTM F1920 Sections 10.8 and 10.9, respectively. However, if booster energy cannot be measured separately it will be included in the idle energy rate measurements.

b. GPR = gallons per rack, LPR = Liters per rack, GPSF = gallons per square foot of rack, LPSM = liters per square fmeter of rack, GPH = gallons per hour, c = [maximum conveyor belt speed (feet/minute)] × [conveyor belt width (feet)], LPH = liters per hour, d = [maximum conveyor belt speed (m/minute)] × [conveyor belt width (m)]

c. PPU Washing Energy is still in format kWh/rack when evaluated; SF_{rack} (SM_{rack}) is Square Feet of rack area (square meters of rack area), same as in PPU water consumption metric.

Table C406.2.7.2(4)
Minimum Efficiency Requirements: Commercial Ovens

Fuel Type	Classification	Idle Rate	Cooking Energy Efficiency, %	Test Procedure
Convection Ovens				
Gas	Full-Size	≤ 12,000 Btu/h (3.5 kW)	≥ 46	ASTM F1496
Electric	Half-Size	≤ 1.0 kW	≥ 71	
	Full-Size	≤ 1.60 kW		
Combination Ovens				
Gas	Steam Mode	≤ 200 P^a + 6,511 Btu/h (≤ 0.059 P^a + 1.9 kW)	≥ 41	ASTM F2861
	Convection Mode	≤ 150 P^a + 5,425 Btu/h (≤ 0.044 P^a + 1.6 kW)	≥ 56	
Electric	Steam Mode	≤ 0.133 P^a + 0.6400 kW	≥ 55	
	Convection Mode	≤ 0.080 P^a + 0.4989 kW	≥ 76	
Rack Ovens				
Gas	Single	≤ 25,000 Btu/h (7.3 kW)	≥ 48	ASTM F2093
	Double	≤ 30,000 Btu/h (8.8 kW)	≥ 52	

[a] P = Pan Capacity: the number of steam table pans the combination oven is able to accommodate in accordance with ASTM F1495

C406.2.7.3 Q03 Efficient Residential Kitchen Equipment.

For projects with Group R-1 and R-2 occupancies, energy credits shall be achieved where all dishwashers, refrigerators, and freezers comply with all of the following:

1. Achieve the Energy Star Most Efficient 2021 label in accordance with the specifications current as of:

1.1 Refrigerators and freezers 5.0, 9/15/2014

1.2 1.2 Dishwashers 6.0, 1/29/2016

2. Be installed before the issuance of the certificate of occupancy.

For Group R-1 where only some guest rooms are equipped with both refrigerators and dishwashers, the table credits shall be prorated as follows:

$$[\textbf{Section C406.2 base credits}] \times \frac{\textbf{floor area of guest rooms with kitchens}}{\textbf{total guest room floor area}} \quad \text{(Equation 4-26)}$$

C406.2.7.4 Q04 Fault detection and diagnostics system.

A project not required to comply with C403.2.3 can achieve energy credits for installing a fault detection and diagnostics system to monitor the HVAC system's performance and automatically identify faults. The installed system shall comply with items 1 through 6 in Section C403.2.3.

C406.3 Renewable and Load Management Credits Achieved.

Renewable energy and load management measures installed in the *building* that comply with Sections C406.3.1 through C406.3.8 shall achieve the credits listed for the occupancy group in Tables C406.3(1) through C406.3(9) or where calculations are required in Sections C406.3 to determine credits or modify the table credits, the credits achieved shall be based upon the Section C406.3 calculations. Measure credits achieved shall be determined in one of two ways, depending on the measure:

1. The measure credit shall be the base energy credit for the measure where no adjustment factor or formula is shown in the description of the measure in Section C406.3.
2. The measure credit shall be the base energy credit for the measure adjusted by a factor or formula as stated in the description of the measure in Section C406.3. Where adjustments are applied, each energy credit shall be rounded to the nearest whole number.

Load management and renewable credits achieved for the project shall be the sum of credits for individual measures included in the project. Credits are

available for the measures listed in this Section. Where a project contains multiple building use groups credits achieved for each building use group shall be summed and then weighted by the gross floor area of each building use group to determine the weighted average project energy credits achieved.

The load management measures in Sections C406.3.2 (G01) through C406.3.7 (G06) require load management control sequences that are capable of and configured to automatically provide the load management operation specified based on indication of a peak period related to high short-term electric prices, grid condition, or peak *building* load. Such a peak period shall, where possible, be initiated by a demand response signal from the controlling entity, such as a utility or service operator. When communications are disabled or unavailable, all demand responsive controls shall continue backup demand response based on a local schedule or *building* demand monitoring. The local *building* schedule shall be adjustable without programming and reflect the electric rate peak period dates and times. The load management control sequences shall be activated for peak period control by either:

1. A certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification, or
2. A device 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, or
3. A device that complies with IEC 62726-10-1, an international standard for the open automated demand response system interface between the appliance, system, or energy management system and the controlling entity, or
4. An interface that complies with the communication protocol required by a controlling entity, to participate in an automated demand response program, or
5. Where the controlling entity does not have a demand response program or protocol available, local demand response control shall be provided based on either:
   - 5.1 *building* demand management controls that monitor *building* electrical demand and initiate controls to minimize monthly or peak time period demand charges, or,
   - 5.2 where *buildings* are less than 25,000 gross square feet, a local *building* schedule that reflects the electric rate peak period dates and times. In this case a binary input to the control system shall be provided that activates the demand response sequence.

Table C406.3(1) Renewable and Load Management Credits for Group R-2, R-4, and I-1 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	9	15	11	17	18	20	19	21	13	10	13	9	9	11	10	9	10	9	7
G01	Lighting load management	C406.3.2	16	7	9	12	12	16	11	14	12	11	16	14	8	11	14	5	7	7	11
G02	HVAC load management	C406.3.3	42	41	21	35	23	37	30	28	28	17	33	24	20	22	23	10	13	15	17
G03	Automated shading	C406.3.4	11	x	7	18	10	13	5	13	12	2	14	7	10	13	11	1	8	8	16
G04	Electric energy storage	C406.3.5	10	10	10	11	10	13	13	14	17	16	13	17	14	13	17	14	14	14	15
G05	Cooling energy storage	C406.3.6	28	6	31	13	22	21	21	37	11	12	22	11	9	17	9	7	17	2	3
G06	SHW energy storage	C406.3.7	17	17	19	18	19	19	20	20	22	19	19	21	19	19	20	18	19	18	17
G07	*Building* thermal mass	C406.3.8	7	2	11	5	16	28	22	27	60	19	43	46	32	58	37	27	45	40	19

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(2) Renewable and Load Management Credits for Group I-2 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	6	6	6	6	6	8	7	9	8	6	8	6	6	7	7	6	7	5	4
G01	Lighting load management	C406.3.2	11	12	13	13	13	12	12	12	6	13	16	12	13	14	15	14	14	12	12
G02	HVAC load management	C406.3.3	10	11	10	10	8	21	10	10	13	11	18	11	12	14	13	12	11	9	7
G03	Automated shading	C406.3.4	1	1	1	1	x	x	x	1	x	x	2	x	x	2	x	x	1	1	x
G04	Electric energy storage	C406.3.5	13	13	13	13	14	15	14	15	15	14	15	15	14	15	15	13	14	13	12
G05	Cooling energy storage	C406.3.6	25	6	33	14	25	19	27	37	27	16	22	19	14	18	11	11	20	2	3
G06	SHW energy storage	C406.3.7	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4
G07	*Building* thermal mass	C406.3.8	6	2	10	4	15	25	20	24	57	18	39	44	31	53	33	26	40	34	14

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(3) Renewable and Load Management Credits for Group R-1 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	9	8	12	9	11	11	10	12	13	9	12	8	9	11	9	8	9	7	5
G01	Lighting load management	C406.3.2	12	12	11	12	12	14	14	13	15	14	13	11	10	11	14	9	11	8	8
G02	HVAC load management	C406.3.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
G03	Automated shading	C406.3.4	2	2	2	3	1	2	3	2	4	3	2	1	1	1	3	1	2	1	1
G04	Electric energy storage	C406.3.5	9	9	10	10	9	13	13	15	13	14	13	14	14	12	16	13	12	12	13
G05	Cooling energy storage	C406.3.6	31	7	38	17	29	24	31	44	26	18	26	16	15	21	11	12	24	2	4
G06	SHW energy storage	C406.3.7	25	25	28	26	28	29	29	30	31	29	30	31	28	29	31	26	28	25	24
G07	*Building* thermal mass	C406.3.8	6	1	10	4	14	24	19	23	53	17	38	41	30	52	33	26	42	37	17

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(4) Renewable and Load Management Credits for Group B Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	14	14	17	15	17	19	18	22	24	17	22	16	14	18	18	14	17	14	11
G01	Lighting load management	C406.3.2	10	11	11	12	11	11	11	12	9	10	11	10	10	11	10	10	11	10	9
G02	HVAC load management	C406.3.3	x	10	10	9	9	3	8	12	7	12	8	11	9	10	12	8	9	10	2
G03	Automated shading	C406.3.4	4	7	7	8	7	8	5	6	6	4	6	5	4	5	5	5	5	4	7
G04	Electric energy storage	C406.3.5	14	15	14	14	16	16	17	16	18	17	16	18	17	17	18	16	15	17	18
G05	Cooling energy storage	C406.3.6	28	7	36	16	27	24	28	45	27	17	27	15	15	20	9	12	25	2	4
G06	SHW energy storage	C406.3.7	5	5	6	6	6	6	7	7	8	7	7	7	7	7	8	6	7	6	6
G07	*Building* thermal mass	C406.3.8	3	1	5	2	6	9	6	7	14	4	11	8	9	15	5	8	12	15	7

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(5) Renewable and Load Management Credits for Group A-2 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	2	2	2	2	2	2	2	3	4	2	3	2	2	3	2	2	2	2	1
G01	Lighting load management	C406.3.2	4	4	5	5	4	5	5	5	5	4	5	5	4	4	5	4	5	4	1
G02	HVAC load management	C406.3.3	32	26	37	28	31	26	27	22	23	20	17	14	19	14	10	16	14	14	1
G03	Automated shading	C406.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
G04	Electric energy storage	C406.3.5	4	4	4	4	5	5	5	5	4	4	4	4	3	4	4	4	3	3	2
G05	Cooling energy storage	C406.3.6	15	4	17	8	12	10	10	16	6	5	7	3	3	4	1	2	4	x	x
G06	SHW energy storage	C406.3.7	13	13	15	14	15	16	16	17	19	16	17	19	16	17	18	15	16	14	13
G07	*Building* thermal mass	C406.3.8	3	1	5	2	7	12	8	10	21	6	15	14	8	18	10	6	12	8	3

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(6) Renewable and Load Management Credits for Group M Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	8	8	12	9	11	12	12	17	17	11	13	9	10	11	10	9	10	9	6
G01	Lighting load management	C406.3.2	16	16	18	19	17	19	19	21	17	18	21	21	18	21	22	18	22	18	16
G02	HVAC load management	C406.3.3	x	15	16	15	15	6	15	21	13	23	15	23	17	19	26	14	17	18	3
G03	Automated shading	C406.3.4	7	11	11	12	11	13	10	11	11	7	11	11	8	10	11	8	9	8	12
G04	Electric energy storage	C406.3.5	6	10	8	10	11	12	11	10	14	11	10	12	10	11	12	11	9	10	8
G05	Cooling energy storage	C406.3.6	40	9	51	22	35	31	34	53	21	17	28	10	11	19	4	9	18	2	2
G06	SHW energy storage	C406.3.7	3	3	4	3	4	4	4	4	5	4	4	5	4	4	5	4	4	4	3
G07	*Building* thermal mass	C406.3.8	5	1	6	3	8	12	10	10	20	7	17	15	14	24	10	13	20	24	12

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(7) Renewable and Load Management Credits for Group E Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	10	11	13	12	13	16	15	21	22	15	19	15	14	17	16	13	16	12	10
G01	Lighting load management	C406.3.2	7	12	12	13	13	15	14	16	13	12	16	16	10	14	18	16	13	14	14
G02	HVAC load management	C406.3.3	18	22	32	23	25	31	26	26	20	23	31	24	20	31	12	18	27	16	9
G03	Automated shading	C406.3.4	7	13	16	12	18	17	17	18	13	12	17	17	10	15	13	14	10	16	17
G04	Electric energy storage	C406.3.5	16	16	18	17	19	21	21	23	26	22	24	24	23	24	24	20	22	19	19
G05	Cooling energy storage	C406.3.6	36	9	46	21	36	32	39	62	39	24	37	22	20	28	13	16	31	3	4
G06	SHW energy storage	C406.3.7	5	5	6	5	6	6	7	7	8	7	7	8	7	7	8	7	7	7	6
G07	*Building* thermal mass	C406.3.8	7	2	11	5	17	28	23	27	63	21	44	48	37	60	38	31	50	47	21

x = Credits excluded from this *building* use type and climate zone.

Table C406.3(8) Renewable and Load Management Credits for Group S-1 and S-2 Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	38	37	55	45	53	53	49	58	66	36	56	38	29	41	36	24	32	23	16
G01	Lighting load management	C406.3.2	13	26	32	28	32	35	36	33	36	31	27	37	32	23	28	36	22	25	22
G02	HVAC load management	C406.3.3	18	46	37	37	28	36	29	26	22	23	17	12	16	13	5	14	8	10	3
G03	Automated shading	C406.3.4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
G04	Electric energy storage	C406.3.5	40	40	47	41	47	44	40	44	42	30	38	31	21	31	26	24	29	23	21
G05	Cooling energy storage	C406.3.6	20	5	21	11	14	14	11	21	5	5	9	2	2	5	1	1	3	x	x
G06	SHW energy storage	C406.3.7	3	3	3	3	4	3	4	4	4	3	4	4	3	3	4	2	2	2	2
G07	*Building* thermal mass	C406.3.8	7	2	12	5	17	29	23	28	66	18	44	47	28	56	37	20	39	29	13

"x" indicates measure is not available for building occupancy in that climate zone

Table C406.3(9) Renewable and Load Management Credits for Other[a] Occupancies

ID	Energy Credit Abbreviated Title	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R01	Renewable Energy	C406.3.1	12	13	16	14	16	18	17	20	21	13	18	13	12	15	14	11	13	10	8
G01	Lighting load management	C406.3.2	11	13	14	14	14	16	15	16	14	14	16	16	13	14	16	14	13	12	12
G02	HVAC load management	C406.3.3	24	24	23	22	20	23	21	21	18	18	20	17	16	18	14	13	14	13	6
G03	Automated shading	C406.3.4	5	6	7	9	8	9	7	9	8	5	9	7	5	8	7	5	6	6	9
G04	Electric energy storage	C406.3.5	14	15	16	15	16	17	17	18	19	16	17	17	15	16	17	14	15	14	14
G05	Cooling energy storage	C406.3.6	28	7	34	15	25	22	25	39	20	14	22	12	11	17	7	9	18	2	3
G06	SHW energy storage	C406.3.7	9	9	11	10	11	11	11	12	13	11	12	13	11	11	12	10	11	10	9
G07	*Building* thermal mass	C406.3.8	6	2	9	4	13	21	16	20	44	14	31	33	24	42	25	20	33	29	13

[a] Other occupancy groups include all Groups except for Groups A-2, B, E, I, M, and R.

C406.3.1 R01 Renewable Energy.

[Special note to consensus committee and staff language coordination: These modifications adapt renewable requirements, passed AM in CEPI-2 to align with revision of energy credits in CEPI-193. The updates match the intent of C406 provisions in CEPI-2 and supersede the C406 language in CEPI-2]

Projects installing *on-site* *renewable energy* systems with a capacity of at least 0.1 watts per gross square foot (1.08 W/m^2) of *building* area or securing off-site renewable energy shall achieve energy credits for this measure calculated as follows:

$$EC_R = EC_{0.1} \times (R_t + R_{off} - R_{ex}) / (0.1 \times PGFA) \quad \text{(Equation 4-27)}$$

where:

EC_R = C406.3.1 R01 energy credits achieved for this project

R_t = actual total rating of on-site renewable energy systems (W)

PGFA = Project gross floor area, ft^2

$EC_{0.1}$ = C406.3.1 R01 base credits from Tables C406.3(1) through C406.3(9)

R_{off} = actual total equivalent rating of off-site renewable energy contracts (W), calculated as follows:

$$R_{off} = TRE / (REN \times 20)$$

where:

TRE = Total off-site renewable electrical energy in kilowatt-hours (kWh) that is procured in accordance with Sections C405.13.2.1 through C405.13.4

REN = Annual off-site renewable electrical energy from Table C405.13.2, in units of kilowatt-hours per watt of array capacity

R_{ex} = rating (W) of *renewable energy resources* capacity excluded from credit calculated as follows:

$$R_{ex} = RR_r + RR_x + RR_c$$

where:

RR_r = rating of on-site renewable energy systems required by Section C405.13.1, without exception (W).

RR_x = rating of *renewable energy resources* used to meet any exceptions of this code (W).

RR_c = rating of *renewable energy resources* used to achieve other energy credits in Section C406 (W).

Where renewable requirements, exceptions, or credits are expressed in annual kWh or Btu rather than Watts of output capacity, they shall be converted as 3413 Btu = 1 kWh and converted to W equivalent capacity as follows:

RR_w = actual total equivalent rating of renewable energy capacity (W), calculated as follows:

$$RR_w = TRE_x / (REN \times PGFA)$$

where:

TRE_x = Total renewable energy in kilowatt-hours (kWh) that is excluded from R01 energy credits

C406.3.2 G01 Lighting Load Management.

Luminaires shall have dimming capability and automatic load management controls that shall gradually reduce *general lighting* power during peak periods. The load management controls shall reduce lighting power in 75 percent of the *building* area by at least 20 percent with *continuous dimming* over a period no longer than 15 minutes. Where less than 75 percent, but at least 50 percent of the project *general lighting* is controlled, the credits from Tables C406.3 shall be prorated as follows:

[*building* area with lighting load management, %] x [table credits for C406.3.2] / 75% (Equation 4-28)

Exception: Warehouse or retail storage *building* areas shall be permitted to achieve this credit by switching off at least 25 percent of lighting power in 75 percent of the *building* area without dimming, or as adjusted by Equation 4-28.

G406.3.3 G02 HVAC Load Management.

Automatic load management controls shall be configured:

1. Where electric cooling is in use to gradually increase the cooling setpoint by at least 3°F (1.7°C) over a minimum of three hours or reduce effective cooling capacity to 60% of installed capacity during the peak period.
2. Where electric heating is in use to gradually decrease the heating setpoint by at least 3°F (1.7°C) over a minimum of three hours or reduce effective heating capacity to 60% of installed capacity during the peak period.
3. Where HVAC systems are serving multiple zones and have less than 70 percent outdoor air required, include controls that provide excess outdoor air preceding the peak period and reduce outdoor air by at least 30 percent during the peak period, in accordance with ASHRAE Standard 62.1 Section 6.2.5.2 Short Term Conditions or provisions for *approved* engineering analysis in the International Mechanical Code Section 403.3.1.1, Outdoor Airflow Rate.

C406.3.4 G03 Automated Shading Load Management.

Where fenestration on east, south, and west exposures exceeds 20 percent of wall area, load management credits shall be achieved as follows:

1. Automatic exterior shading devices or dynamic glazing that are capable of reducing solar gain (SHGC) through sunlit fenestration by at least 50 percent when fully closed shall receive the full credits in Tables C406.3(1) through C406.3(9). The exterior shades shall have fully open and fully closed SHGC determined in accordance with AERC 1.
2. Automatic interior shading devices with a minimum solar reflectance of 0.50 for the surface facing the fenestration shall receive 40 percent of the credits in Tables C406.3(1) through C406.3(9).
3. All shading devices, dynamic glazing, or shading attachments shall:
   3.1. provide at least 90 percent coverage of the total fenestration on east, south, and west exposures in the *building*
   3.2. be automatically controlled and shall modulate in multiple steps or continuously the amount of solar gain and

light transmitted into the space in response to peak periods and either daylight levels or solar intensity

3.3. include a manual override located in the same enclosed space as the shaded vertical fenestration that shall override operation of automatic controls no longer than four hours. Such override shall be locked out during peak periods.

For this section, directional east, south, or west exposures shall exclude fenestration that is plus or minus 45 degrees of facing true north in the northern hemisphere. In the southern hemisphere, where the south exposure is referred to, it shall be replaced by the north exposure and the referenced south exposure shall be replaced by the north exposure.

C406.3.5 G04 Electric Energy Storage.

Electric storage devices shall be charged and discharged by automatic load management controls to store energy during non-peak periods and use stored energy during peak periods to reduce *building* demand. Electric storage devices shall have a minimum capacity of 1.5 Wh/ft^2 (87 Wh/m^2) of gross *building* area. Base credits in Tables C406.3-1 through C406.3-8 are based on installed electric storage of 5 Wh/ft^2 (54 Wh/m^2) and shall be prorated for actual installed storage capacity between 1.5 and 15 Wh/ft^2 (16 to 160 Wh/m^2), as follows:

$$\frac{\text{electric storage capacity, Wh/ft}^2\ (\text{Wh/m}^2)}{5\ (54)} \times [\textbf{C406.3.5 Credits from C406.3 Tables}] \qquad \text{(Equation 4-29)}$$

Larger energy storage shall be permitted; however, credits are limited to the range of 1.5 to 15 Wh/ft^2 (16 to 160 Wh/m^2).

C403.6.6 G05 Cooling Energy Storage.

Automatic load management controls shall be capable of activating ice or chilled water storage *equipment* to reduce demand during summer peak periods. Storage tank standby loss shall be demonstrated through analysis to be no more than 2 percent of storage capacity over a 24 hour period for the cooling design day.

Base credits in Section C406.3 are based on storage capacity of the design peak hour cooling load with a 1.15 sizing factor. Credits shall be prorated for installed storage systems sized between 0.5 and 4.0 times the design day peak hour cooling load, rounded to the nearest whole credit. Larger storage shall be permitted but the associated credits are limited to the range above. Energy credits shall be determined as follows:

$$EC_S = EC_{1.0} \times (1.44 \times SR + 0.71) / 2.15 \qquad \text{(Equation 4-30)}$$

where:

EC_S = Cooling Storage credit achieved for Project

$EC_{1.0}$ = G05 base energy credit for building use type and climate zone based on 1.0 ton-hours storage per design day ton (kWh/kW) of cooling load

SR = Storage ratio in Btu storage per peak design day Btu/hr cooling load (kWh/kW) where $0.5 \le SR \le 4.0$

G406.3.7 G06 SWH Energy Storage.

Where SHW is heated by electricity, automatic load management controls comply with ANSI/CTA-2045-B shall preheat stored SHW before the peak period and suspend electric water heating during the peak period. Storage capacity shall be provided by either:

1. Preheating water above 140°F (60°C) delivery temperature with at least 1.34 kWh of energy storage per kW of water-heating capacity. Tempering valves shall be provided at the water heater delivery location.
2. Providing additional heated water tank storage capacity above peak SHW demand with equivalent peak storage capacity to item 1. Where heat pump water heating is used, the credits achieved shall be 1/3 of the credits in Tables C406.3(1) through C406.3(9).

C406.3.8 G07 Building Thermal Mass.

The project shall have additional passive interior mass and a night flush control of the HVAC system. The credit is available to projects that have at least 80 percent of gross floor area unoccupied between midnight and 6:00 a.m. The project shall meet the following requirements:

1. Interior to the *building envelope* insulation, provide 10 lb/ft^2 (50 kg/m^2) of project *conditioned floor area* of passive thermal mass in the *building* interior *wall*, the inside of the *exterior wall*, or interior *floor construction*. Mass *construction* shall have mass surfaces directly contacting the air in *conditioned spaces* with directly attached gypsum panels allowed. Mass with carpet or furred gypsum panels or *exterior wall* mass that is on the exterior of the insulation layer (e.g., the portion of CMU block on the exterior of insulation filled cell cavities) shall not be included toward the *building* mass required.
2. HVAC units for 80 percent or more of the supply airflow in the project shall be equipped with outdoor air economizers and fans that have variable or low speed capable of operating at 66 percent or lower airflow and be included in the night flush *control* sequence.
3. Night flush controls shall be configured with the following sequence or another night flush strategy shall be permitted where demonstrated to be effective, avoids added morning heating, and is approved by the *authority having jurisdiction*.
   - 3.1. Summer mode shall be activated when outdoor air temperature exceeds 70°F (21°C) and shall continue uninterrupted until deactivated when outdoor air temperature falls below 45°F (7°C). During summer mode, the occupied cooling *set point* shall be set 1°F (0.6°C) higher than normal and the occupied heating *set point* shall be *reset* 2°F (1.1°C) lower than normal.
   - 3.2. When all the following conditions exist, night flush shall be activated:
     - 3.2.1. Summer mode is active in accordance with item 3.1
     - 3.2.2. Outdoor air temperature is 5°F (2.8°C) or more below indoor average zone temperature
     - 3.2.3. Indoor average zone temperature is greater than morning occupied heating *set point*
     - 3.2.4. In climate zones 0A through 3A, outdoor dewpoint is below 50°F (10°C) or outdoor air enthalpy is less than indoor air enthalpy
     - 3.2.5. Local time is between 10:00 pm and 6:00 am.
   - 3.3. When night flush is active, *automatic* night flush controls shall operate outdoor air *economizers* at low fan speed not exceeding 66 percent during the unoccupied period with *mechanical cooling* and heating locked out.
4. The project shall demonstrate a contractual obligation for post-occupancy commissioning and control tuning in the spring or fall season to tune the summer mode activation setpoints and occupied heating setpoint or other algorithms to achieve minimal morning heating due to night flush activation while maintaining comfort conditions. Commissioning shall include monitoring of time series space temperature, heating, and cooling operation to demonstrate both night cooling and minimization of morning heating along with monitoring of post-tuning operation to verify tuned parameters. Operating manuals shall include recommendations for tuned parameters and narrative training for operating staff on night flush automated settings. Reporting shall be in compliance with C408.

Revise as follows:

C407.2 Mandatory requirements.

Compliance based on total *building* performance requires that a proposed design meet all of the following:

1. The requirements of the sections indicated within Table C407.2.

2. An annual energy cost that is less than or equal to ~~80~~ the percentage of the annual energy cost (PAEC) of the *standard reference design* calculated in Equation 4-31. 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. The reduction in energy cost of the proposed design associated with *on-site renewable energy* shall be not more than 5 percent of the total energy cost. The amount of renewable energy purchased from off-site sources shall be the same in the *standard reference design* and the *proposed design*.

Exception: Jurisdictions that require site energy (1 kWh = 3413 Btu) rather than energy cost as the metric of comparison.

PAEC = 100 x (0.85 + 0.025 - ECr/1000) (Equation 4-31)

where:

PAEC = Percentage of annual energy cost applied to standard reference design

EC_r = Energy efficiency credits required for the *building* in accordance with Section C406.1 (do not include load management and renewable credits)

TABLE C407.2 REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION [a]	TITLE
Envelope	
C402.5	Air leakage—thermal envelope
Mechanical	
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies C403.4, except C403.4.3, C403.4.4 and C403.4.5 Heating and cooling system controls C403.5.5 Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems

C406.1.2	Additional renewable and load management credit requirements
C408	Maintenance information and system commissioning

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

Note, energy credits for Additions and Alterations have been removed from CEPI-193 for consideration under CEPI-217.

Add new text as follows:

APPENDIX CD ENERGY CREDITS

CD101 General

CD101.1 Purpose.

This purpose of this Appendix is to supplement the *International Energy Conservation Code and* requires projects to comply with Advanced Energy Credit Package requirements.

CD101.2 Scope.

This Appendix applies to all *buildings*, in accordance with Section C406.1, required to comply with, either Section C406.1.1 or Section C406.1.3.

CD102 Advanced Energy Credit Package

CD102.1 Advanced Energy Credit Package requirements.

The requirements of this Section supercede the requirements of Section C406.1.1. Projects shall comply with measures from C406.2 to achieve the minimum number of required efficiency credits from Table CD102.1 based on building occupancy group and climate zone. Projects with multiple *occupancies*, unconditioned parking garages, alterations, and *buildings* with separate shell-and- core and build-out *construction* permits shall comply as follows:

Where a project contains multiple occupancies, credits in Table CD102.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406 and Appendix CD.

Exceptions:

1. Unconditioned parking garages that achieve 50% of the credits required for use groups S-1 and S-2 in Table CD102.1.
2. Portions of *buildings* devoted to manufacturing or industrial use.

Table CD102.1
Energy Credit Requirements by Building Occupancy Group

Building Occupancy Groups	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1	179	174	188	197	200	200	200	200	200	200	200	200	193	200	200	200	200	200	200
I-2	78	75	73	71	80	90	100	85	90	97	83	90	99	90	96	107	106	130	117
R-1	106	100	110	105	109	122	123	125	131	137	129	136	157	139	147	171	158	180	176
B	114	110	112	115	108	107	116	111	114	126	118	123	135	125	125	152	142	153	141
A-2	83	81	82	82	86	86	108	91	97	126	99	111	147	117	113	160	143	163	151
M	113	113	121	118	123	127	116	116	133	109	100	92	99	134	125	171	146	150	137
E	91	95	91	100	96	100	105	104	101	113	110	110	120	117	122	131	132	126	131
S-1 and S-2	108	106	111	109	109	108	89	106	108	134	100	130	200	143	123	200	190	189	148
All Other	54	53	55	56	57	60	61	60	63	68	60	65	73	68	69	84	79	84	78

Add new standard(s) as follows:

AERC Attachments Energy Rating Council

355 Lexington Ave 15th Floor

New York, NY 10017

AERC 1-2017 Procedures for Determining Energy Performance Properties of Fenestration Attachments

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

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 International Electrotechnical Commission.

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
Roman CA 94583 OpenADR OpenADR Alliance.

OpenADR 2.0a and 2.0b – 2019: Profile Specification Distributed Energy Resources

IES Illuminating Engineering Society

120 Wall street, Floor 17

New York, NY 10005-4001

"The Interactive Illuminance Selector," *available at*

https://www.ies.org/standards/lighting-library/the-interactive-illuminance-selector/ *which includes minimum recommended illuminance levels from the following standards:*

ANSI/IES RP-1-2020	Recommended Practice: Lighting Office Spaces
ANSI/IES RP-2-2020	Recommended Practice: Lighting Retail Spaces
ANSI/IES RP-3-2020	Recommended Practice: Lighting Educational Facilities
ANSI/IES RP-4-2020	Recommended Practice: Lighting Library Spaces
ANSI/IES RP-6-2020	Recommended Practice: Lighting Sports and Recreational Areas
ANSI/IES RP-7-2020	Recommended Practice: Lighting Industrial Facilities
ANSI/IES RP-8-2021	Recommended Practice: Lighting Roadway and Parking Facilities
ANSI/IES RP-9-2020	Recommended Practice: Lighting Hospitality Spaces
ANSI/IES RP-10-2020	Recommended Practice: Lighting Common Applications

ANSI/IES RP-11-2020	Recommended Practice: Lighting for Interior and Exterior Residential Environments
ANSI/IES RP-27-2020	Recommended Practice: Photobiological Safety for Lighting Systems
ANSI/IES RP-29-2020	Recommended Practice: Lighting Hospital and Healthcare Facilities
ANSI/IES RP-30-2020	Recommended Practice: Lighting Museums
ANSI/IES RP-41-2020	Recommended Practice: Lighting Theaters and Worship Spaces

Update Standards as follows:

ASTM

ASTM International

100 Barr Harbor Drive, P.O. Box C700

West Conshohocken, PA 19428-2959

F1696—~~2018~~ 2020	Standard Test Method for Energy Performance of Stationary-Rack, Door-Type Commercial Dishwashing Machines
F1920—~~2015~~ 2020	Standard Test Method for Performance of Rack Conveyor Commercial Dishwashing Machines

Reason Statement for as modified:

Revision summary compared to original CEPI-193-21 proposal:

- Reduced requirements from original proposal to fit new IECC cost effectiveness criteria and limit LPD reduction for demonstration package to 10%
- Included updates from Standard 90.1 public review on a similar proposal
- Incorporate CEPI 198,199,200 verbatim related to commercial kitchen equipment (Q02)
- Combined fenestration, wall insulation, and roof insulation into fewer measures (E04, E05, E06)
- Increased VT requirement in E06 to avoid reduced daylighting and aligned U-factors/SHGC with 189.1.
- Remove requirements for additions and alterations and clarify core/shell & build out
- Revise residential piping configuration (W09) to just fixture flow reduction
- Air leakage coordinated with CEPI-3, CEPI-58 & CEPI-71
- Window shading (G03) coordinated with CEPI-195 & CEPI-196
- Removed residential control credits for H04 & L05 except for the R-2/R4/I-1 table
- Updated H01 TSPR HVAC based credit inputs after coordination with CEPI-76
- Revise L03 for more clarity on occupancy sensor function
- Revise L04 to simplify and remove tertiary daylight areas
- Revised renewable credit (R01) to match CEPI-2, including off-site and removing on-site cap
- Incorporate language updates from working group and other code officials
- Make references to peak periods more consistent, with clearer language about load management for jurisdictions without a demand response program

A track changes comparison document is available as a pdf.

The “achieved energy credits” moved to Section C406.2 with the following resulting requirements:

Table 1: Energy Credit building thresholds

Project Type	HVAC Type	Building Size, floor area	C406.1.1 Efficiency	C406.1.2 LM/ renewable
New & core/shell portion with final Light or HVAC	Any	>2000 sq. ft.	Yes	No
		>5000 sq. ft. conditioned	Yes	Yes
Core/Shell portion without final Light & HVAC	Central HVAC	>2000 sq. ft.	50%	See Above
	Local HVAC	>2000 sq. ft.	33%	
Build out with initial Lighting or HVAC after separate core/shell permit	Central HVAC	>1000 sq. ft. build out area	33%	NA
	Local HVAC		50%	
	Core/shell via C407*		0%	

* For build out to be exempt, prior C407 performance must be 2021 IECC or later, indicating full credits were achieved in the core/shell building

In the 2021 IECC, energy credit measures were expanded from 8 alternate options to 15 measures that can be flexibly selected to achieve a 2.5% level of building energy cost savings. A similar package of measures has been proposed for ASHRAE Standard 90.1- 2022, with 32 energy efficiency, renewable energy, and load management measures available. Building-type-specific targets were developed with a goal of 5% total energy cost savings.

This proposal includes 31 energy efficiency measures and builds on the former energy credit approaches with a base goal of around 6-7% energy savings. The energy efficiency credits here are based on site energy use and each credit represents 1/10 of 1% building energy use.

Outline of changes in energy efficiency credit measures from the tech brief shown in Table 2.

Table 2: Energy Efficiency Credit Measures compared to 2021 IECC

ID	New C406	Measure Name	2021 IECC	Compare to 2021
E01	C406.2.1.1	Envelope performance (90.1 Appendix C basis)		New

E02	C406.2.1.2	UA reduction (15%)	C406.8	Same
E03	C406.2.1.3	Envelope leakage reduction	C406.9	Same
E04	C406.2.1.4	Add Roof Insulation	C406.8 sim	New
E05	C406.2.1.5	Add Wall Insulation	C406.8 sim	New
E06	C406.2.1.6	Improve Fenestration	C406.8 sim	New
H01	C406.2.2.1	HVAC performance (TSPR)		New
H02	C406.2.2.2	Heating efficiency	C406.2.1	Expanded
	in above	5-20% Heat efficiency by formula	C406.2.3	in H02
H03	C406.2.2.3	Cooling efficiency	C406.2.2	Expanded
	in above	5-20% Cool efficiency by formula	C406.2.4	in H03
H04	C406.2.2.4	Residential HVAC control		New
H05	C406.2.2.5	DOAS/fan control	C406.6	Modified
W01	C406.2.3.1 a	SHW preheat recovery	C406.7.2	Same
W02	C406.2.3.1 b	Heat pump water heater	C406.7.4	Modified
W03	C406.2.3.1 c	Efficient gas water heater	C406.7.3	Same
W04	C406.2.3.2	SHW pipe insulation		New
W05	C406.2.3.3 a	Point of use water heaters		New
W06	C406.2.3.3 b	Thermostatic balancing valves		New
W07	C406.2.3.3 c	SHW heat trace system		New
W08	C406.2.3.4	SHW submeters		New
W09	C406.2.3.5	SHW distribution sizing		New
W10	C406.2.3.6	SHW shower drain heat recovery		New
P01	C406.2.4	Energy monitoring	C406.10	Same
L01	C406.2.5.1	Lighting performance		*Future*
L02	C406.2.5.2	Lighting dimming & tuning	C406.4	Expanded
L03	C406.2.5.3	Increase occupancy sensor		New
L04	C406.2.5.4	Increase daylight area		New
L05	C406.2.5.5	Residential light control		New
L06	C406.2.5.6	Lighting power reduction	C406.3.1	Expanded
	in above	*20% LPA reduction*	C406.3.2	in L06
	in above	Residential lamp efficacy	C406.3.3	in L06
Q01	C406.2.7.1	Efficient elevators		New

Q02	C406.2.7.2	Efficient commercial kitchen equipment	C406.12	Same
Q03	C406.2.7.3	Efficient residential kitchen equipment		New
Q04	C406.2.7.4	Fault detection and diagnosis (FDD)	C406.11	Same

Renewable and Load Management measures add cost savings based on grid cost impact represented by a time- of-use electric price structure. These measures are new, with the exception of renewable that was included in the 2021 IECC. The list of load management and renewable measures is as follows:

- R01: On-Site Renewable Energy (2021 IECC Section C406.5)
- G01: Lighting load management
- G02: HVAC load management
- G03: Automated shading
- G04: Electric energy storage
- G05: Cooling energy storage
- G06: SHW energy storage
- G07: Building thermal mass and night flush

Bibliography:

Hart, R, J. McNeil, M. Tillou, E. Franconi, C. Cejudo, C. Nambiar, H. Nagada, D. Maddox, J. Lerond, M. Rosenberg. 2021. Expanded Energy and Load Management Credits in Energy Codes. PNNL-32001, Pacific Northwest National Laboratory, Richland, WA. https://www.energycodes.gov/sites/default/files/2021-07/TechBrief_EnergyCredits_July2021.pdf

Cost Impact:

The code change proposal will increase the cost of construction.

While baseline prescriptive requirements usually undergo individual review for cost effectiveness, the approach to energy credit measures is different. Each measure can be selected for a particular building; however, not all measures are required, so the approach is to find at least one package of measures that are shown to be cost effective.

The energy credit requirements are justified based on a selection of a package of measures that meet the requirement and are cost effective for each building use type and climate zone. About one quarter of the measures were selected for inclusion in the cost effectiveness analysis, based on their general applicability and reliable savings. A requirement package was determined for evaluation of cost effectiveness:

- The energy package included standard efficiency measures with a cap of 9% energy savings for required credits to allow for measure selection flexibility.
- Table 3 provides an overview of measures selected for inclusion in the demonstration package. Measures are selected with the goal of 6-7% savings or 60-70 credits for this package. Some building types in some climate zones can accommodate more savings; however, the requirement is capped at 9%. Measure selection may be climate zone specific. For example, cooling efficiency only makes sense in warm climate zones. The climate zones (CZ) or application of measures is shown along with individual measure lives shown for determining cost effectiveness. These measure lives are based on well documented research and may vary from simplified measure lives.

Table 3: Energy Measures selected for cost effective demonstration package:

ID	Energy Credit Measure	Measure Life, yr	Multifamily	Healthcare	Hotel/Motel	Office	Restaurant	Retail	Education	Wareh
E01	Glazing U & SHGC reduction	40	CZ 0A-1A	all CZ	all CZ	all CZ			all CZ	
E02	Envelope UA reduction	40						CZ 4-8		
H02	Heating efficiency	18		5%, CZ 5-8				5%, CZ 7-8		10%, C
H03	Cooling efficiency.	15	CZ 0-2	10%, CZ 0-2	15%, CZ 0-2	15%, CZ 0-2	15%, CZ 0-3B	15%, CZ 0-3B	CZ 0-3B	CZ 0
H04	Residential HVAC control.	15	all CZ							
W02	Heat pump water heater or HR	19		30% all CZ	30% all CZ		30% all CZ	CZ 0-5		CZ
W03	Efficient gas water heater	15		70% all CZ	70% all CZ		70% all CZ			
W05	Point of use water heater	15				all CZ			all CZ	
W06	Thermostatic balancing valves	15		all CZ	all CZ					
W08	SWH flow reduction	15	all CZ		all CZ					
L04	Increase daylighting area	15						10% CZ 0-6		all
L06	Light power reduction	20	5% all CZ	10% all CZ	10% all CZ	10% all CZ	10% all CZ	10% all CZ	10% all CZ	10% a
Q02	Efficient kitchen equipment	15					all CZ			
Q04	Fault detection	15		all CZ	all CZ	all CZ		CZ 4B, 7-8	all CZ	

Based on this selection of measures, the scalar value or payback for each building type for the selected group of measures is given in Table 4. This uses energy prices with the more conservative assumption that there is no social cost of carbon. This represents the cost for all measures included in the package divided by the annual consumer energy cost savings. Based on the IECC adopted economic criteria, a scalar limit or threshold is developed for each combination of climate zone and building type based on the individual measure lives shown in Table 5, based on a measure life weighted by the measure cost savings. The measures included in the base package that help determine the credits required are adjusted so that all building types in all climate zones have a consumer payback that is less than the scalar limit, indicating cost effectiveness for the efficiency credit requirements. The threshold divided by the payback is shown in Table 6.

Table 4: Scalar Ratio (or simple payback) of selected demonstration measure package for each building use type and climate zone (no social cost of carbon included):

Building Use Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	
Multifamily/Dormitory	5.0	5.2	6.0	5.0	5.6	5.5	5.3	5.2	4.7	4.7	4.6	5.1	4.4	4.2	5.0	4.1	4.2	4.2	
Healthcare	3.3	3.6	3.8	3.8	3.8	4.5	2.9	3.1	2.6	2.6	2.8	2.4	2.7	2.8	2.0	2.7	2.5	2.2	
Hotel/Motel	4.1	4.5	5.2	5.1	5.3	6.1	6.0	6.1	6.1	3.7	3.7	3.9	3.7	3.6	3.8	3.5	3.6	3.2	
Office Buildings	8.3	7.5	8.2	7.9	8.4	8.9	6.2	6.3	6.7	5.8	5.7	6.2	5.7	5.5	6.1	5.2	5.4	5.3	
Restaurant Buildings	3.0	3.2	3.8	3.5	3.8	4.1	4.1	4.1	4.2	4.0	4.0	4.0	3.9	3.9	3.9	3.8	3.8	3.6	
Retail Buildings	3.2	3.4	3.9	3.7	4.4	4.5	5.2	5.1	3.2	4.4	5.2	6.6	4.1	5.0	5.9	3.4	4.0	6.3	
School/Education Buildings	5.0	5.6	6.6	6.1	6.9	7.7	7.7	7.6	5.4	4.7	4.7	5.1	4.6	4.5	5.0	4.2	4.5	4.2	
Warehouse and Semiheated	8.2	8.0	9.8	9.1	10.5	10.2	12.3	11.9	8.9	4.1	6.1	5.8	3.1	4.5	6.1	2.2	3.0	2.3	

Table 5: Based on the 7% discount rate IECC cost effectiveness criteria, the following thresholds apply:

Building Use Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	
Multifamily/Dormitory	13.1	13.1	13.7	12.3	12.5	12.5	13.1	13.0	12.9	13.0	12.9	13.2	13.0	12.9	13.2	13.0	13.0	13.1	
Healthcare	14.3	14.3	15.2	15.1	16.0	15.9	17.7	17.5	18.0	18.1	18.0	18.4	17.7	17.8	18.5	17.6	17.8	17.8	
Hotel/Motel	13.4	13.5	14.1	14.0	14.6	14.6	15.3	15.1	15.6	15.8	15.8	15.4	15.4	15.6	15.4	15.5	15.4	15.7	
Office Buildings	15.6	15.2	15.9	15.9	16.6	16.7	18.0	18.1	18.0	18.5	18.5	18.5	18.7	18.7	18.6	18.9	18.9	19.0	
Restaurant Buildings	11.6	11.6	11.7	11.7	11.8	11.8	11.9	11.9	11.8	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	
Retail Buildings	12.0	12.0	12.2	12.1	12.3	12.3	12.4	12.4	12.5	15.0	12.8	13.0	15.5	13.4	12.8	16.3	15.2	16.3	
School/Education Buildings	14.4	14.7	15.7	15.5	16.4	16.8	17.7	17.7	18.2	18.7	18.8	18.7	18.9	18.9	18.8	19.1	19.0	19.1	
Warehouse	12.4	12.4	12.6	12.5	12.7	12.7	12.8	12.8	12.9	12.8	12.9	12.9	12.8	12.9	12.9	12.8	12.9	12.8	

Table 6: Ratio of Threshold to Actual Scalar Ratio; Values greater than 1.0 meet criteria

Building Use Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	
Multifamily/Dormitory	2.6	2.5	2.3	2.5	2.2	2.3	2.5	2.5	2.7	2.7	2.8	2.6	3.0	3.1	2.6	3.1	3.1	3.1	
Healthcare	4.4	3.9	4.0	4.0	4.2	3.6	6.0	5.6	6.9	6.8	6.5	7.6	6.5	6.4	9.1	6.6	7.2	8.0	
Hotel/Motel	3.3	3.0	2.7	2.8	2.7	2.4	2.6	2.5	2.6	4.3	4.2	4.0	4.2	4.3	4.1	4.4	4.3	4.9	
Office Buildings	1.9	2.0	1.9	2.0	2.0	1.9	2.9	2.9	2.7	3.2	3.3	3.0	3.3	3.4	3.1	3.6	3.5	3.6	
Restaurant Buildings	3.9	3.6	3.1	3.3	3.1	2.9	2.9	2.9	2.8	3.0	3.0	3.0	3.1	3.1	3.0	3.2	3.2	3.3	
Retail Buildings	3.8	3.6	3.1	3.3	2.8	2.7	2.4	2.4	3.9	3.4	2.5	2.0	3.7	2.7	2.2	4.8	3.8	2.6	
Education Buildings	2.9	2.6	2.4	2.5	2.4	2.2	2.3	2.3	3.3	4.0	4.0	3.6	4.1	4.2	3.8	4.5	4.2	4.5	
Warehouse	1.5	1.6	1.3	1.4	1.2	1.3	1.0	1.1	1.4	3.1	2.1	2.2	4.1	2.9	2.1	5.9	4.3	5.5	

The same selection of measures is also evaluated with societal evaluation criteria based on energy prices that include a social cost of carbon and a 3% discount rate.

- The payback or scalar ratio including cost of carbon is given in Table 7.
- The scalar limit or threshold using a 3% discount rate is shown in Table 8.
- The threshold divided by the payback is shown in Table 9.

Using these societal criteria, the paybacks (scalar ratios) are shorter, the thresholds are longer, and the ratio of the two are higher, indicating that all building types meet the adopted cost effectiveness criteria.

Table 7: Scalar Ratio (or simple payback) of selected demonstration measure package for each building use type and climate zone (with social cost of carbon included):

Building Use Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	
Multifamily/Dormitory	4.3	4.5	5.3	4.2	4.8	4.6	4.7	4.6	4.0	4.2	4.0	4.6	3.8	3.6	4.5	3.6	3.6	3.7	
Healthcare	2.7	3.0	3.1	3.2	3.2	3.8	2.6	2.7	2.3	2.3	2.4	2.2	2.4	2.4	1.8	2.3	2.1	1.9	
Hotel/Motel	3.3	3.7	4.2	4.1	4.3	4.9	4.9	5.0	5.0	3.0	3.1	3.1	3.0	3.0	3.0	2.8	2.9	2.6	
Office Buildings	6.8	6.2	6.8	6.6	7.1	7.5	5.4	5.4	5.8	5.1	5.0	5.5	5.0	4.9	5.4	4.7	4.8	4.8	
Restaurant Buildings	2.3	2.4	2.8	2.7	2.8	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.8	2.8	2.8	2.7	2.7	2.6	
Retail Buildings	2.5	2.7	3.1	3.0	3.5	3.6	4.2	4.0	2.6	3.4	4.1	5.3	3.2	4.0	4.7	2.6	3.1	4.7	
School/Education Buildings	4.2	4.7	5.6	5.2	6.0	6.7	6.9	6.8	4.9	4.3	4.3	4.7	4.3	4.1	4.6	3.9	4.2	3.9	
Warehouse and Semiheated	6.5	6.4	7.8	7.2	8.3	8.1	9.8	9.5	7.1	3.1	4.7	4.4	2.3	3.3	4.7	1.6	2.2	1.7	

Table 8: Based on the 3% discount rate IECC cost effectiveness criteria, the following thresholds apply:

Building Use Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	
Multifamily/Dormitory	13.9	13.9	14.5	12.9	13.2	13.2	13.9	13.8	13.6	13.7	13.7	14.0	13.7	13.6	14.1	13.7	13.7	13.9	1
Healthcare	15.1	15.2	16.1	16.0	17.0	17.0	19.3	19.1	19.7	19.9	19.7	20.3	19.2	19.4	20.4	19.1	19.3	19.3	1
Hotel/Motel	14.1	14.2	14.8	14.7	15.4	15.4	16.1	16.0	16.5	16.8	16.7	16.3	16.3	16.5	16.3	16.4	16.3	16.6	1
Office Buildings	16.4	16.0	16.9	16.9	17.6	17.9	19.6	19.8	19.5	20.4	20.4	20.3	20.7	20.7	20.5	21.0	21.0	21.2	2
Restaurant Buildings	12.4	12.4	12.5	12.5	12.6	12.6	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.8	12.8	1
Retail Buildings	12.8	12.8	13.0	13.0	13.1	13.2	13.2	13.3	13.4	16.7	13.8	14.1	17.5	14.6	13.8	18.5	17.0	18.3	1
School/Education Buildings	15.2	15.5	16.7	16.5	17.5	18.0	19.4	19.4	20.0	20.9	21.0	20.9	21.3	21.2	21.1	21.5	21.4	21.6	2
Warehouse and Semiheated	13.2	13.2	13.5	13.4	13.6	13.6	13.8	13.8	13.9	13.8	13.9	13.8	13.8	13.8	13.9	13.8	13.8	13.7	1

Table 9: Ratio of Threshold to Actual Scalar Ratio; Values greater than 1.0 meet criteria

Building Use Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	
Multifamily/Dormitory	3.2	3.1	2.7	3.1	2.7	2.8	2.9	3.0	3.4	3.3	3.4	3.1	3.6	3.7	3.1	3.8	3.8	3.7	
Healthcare	5.6	5.1	5.1	5.0	5.4	4.5	7.5	7.0	8.5	8.5	8.1	9.4	8.2	8.0	11.3	8.3	9.0	10.1	1
Hotel/Motel	4.3	3.9	3.6	3.6	3.5	3.1	3.3	3.2	3.3	5.5	5.5	5.2	5.4	5.6	5.3	5.8	5.6	6.3	
Office Buildings	2.4	2.6	2.5	2.5	2.5	2.4	3.6	3.6	3.4	4.0	4.1	3.7	4.1	4.2	3.8	4.5	4.4	4.5	
Restaurant Buildings	5.5	5.1	4.5	4.7	4.4	4.1	4.3	4.2	4.2	4.4	4.4	4.4	4.6	4.6	4.5	4.7	4.7	4.9	
Retail Buildings	5.1	4.8	4.2	4.4	3.7	3.7	3.2	3.3	5.2	4.9	3.4	2.7	5.5	3.7	2.9	7.1	5.4	3.9	
School/Education Buildings	3.7	3.3	3.0	3.2	2.9	2.7	2.8	2.9	4.1	4.9	4.9	4.5	5.0	5.1	4.6	5.5	5.1	5.5	
Warehouse and Semiheated	2.0	2.1	1.7	1.9	1.6	1.7	1.4	1.5	2.0	4.5	2.9	3.1	6.1	4.1	3.0	8.7	6.3	8.1	

Notes from original reason statement:

1. The Code Approach

Energy codes include mandatory requirements that all buildings must fulfill prescriptive requirements that can be used without following a performance path, or whole-building performance paths where equivalent energy performance to the prescriptive path is demonstrated. To fit into the existing code structure, additional energy credits constitute a new prescriptive requirement; however, instead of all measures being required, the building designer can select from various options to achieve a defined level of energy performance. To maintain equivalent energy impact, whole-building performance paths must be adjusted to reflect the impact of the required energy credits.

2. Energy Credit Development Energy credits have been developed from typical measures used in green building programs, new construction utility incentive programs, and Advanced Energy Design Guidelines (ASHRAE 2019b). A detailed discussion

of the methodology used to develop individual credits can be found in the published Energy Credit Tech Brief at https://www.energycodes.gov/stretch-codes

Referenced Standards.

ANSI/CTA-2045-B-2018 Modular Communications Interface for Energy Management: https://shop.cta.tech/products/modular- communications-interface-for-energy-management
ANSI/IES Various Recommend Practices regarding illuminance levels

OpenADR 2.0a and 2.0b – 2019: Profile Specification Distributed Energy Resources: https://www.openadr.org/specification-download

The following notes should be included in the Commentary:

Section C406.2.3.5 *Note to adopting jurisdictions, consider including the following commentary to clarify the requirements of C406.2.3.5 Where low water supply pressures are anticipated, user satisfaction may be enhanced if flow restrictors are specified to provide ≥80% of the rated flow at 20 psi (140 kPa).Where the distribution sizing protocol is applied to other than multifamily residential buildings, a variance to the plumbing code may be needed.*

Section C406.3.1 *On-site renewable energy may include thermal service water heating or pool water heating in which case ratings in Btu/h can be converted to W where W = Btu/h / 3.413.*

Section C406.3.4 *This credit can be met by exterior roller, movable blind, or movable shutter shading devices; however fixed overhang, screen or shutter shading will not meet the requirement. Roller shades that reject solar gain but still allow a view are allowed as long as they provide an effective 50% reduction in net solar gain, e.g., have a shading coefficient of less than 0.5 for the shading material itself. Interior shading devices will not meet the requirement. Electrochromatic windows that achieve 50% of SHGC would qualify.*

Section C406.3.8 *The simplified night flush sequence described will operate in "Summer Mode" below the 70F OA trigger temperature down until OA of 45F is hit when the "Summer Mode" is deactivated until the OA rises above 70F again. These activation temperatures may need customization for the local climate. Other strategies may be implemented that include connection to weather prediction information or cool the space below the heating setpoint and adjust the morning heating setpoint to avoid morning reheating.*

Section C407.2 *The formula for PAEC in Section C407.2 allows adjustment for the current energy credits required in the IECC (2.5% or 0.025) and the new energy efficiency credit requirements that come from Section C406.1.1.*

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-027-21 Thermal Envelope
CDP ID #	511
Code	IECC CE
Code Section(s)	C402, C402.1, C402.1.1, C402.1.1.1, C402.1.2, C402.1.3, C402.1.4, C402.1.4.1, C402.1.4.1.1, C402.1.4.1.2, C402.1.4.1.3, C402.1.4.2, C402.1.5, C402.2, C402.2.1, C402.2.1.1, C402.2.1.2, C402.2.1.3, C402.2.1.4, C402.2.1.5, C402.2.2, C402.2.3, C402.2.4, C402. New Section n
Location	base
Proponent	Jay Crandell jcrandell@aresconsulting.biz
Proposal Status	SC rev
Subcommittee	CE Envelope
Subcommittee Notes	**Reason Statement**: Proposal reorganizes the section for better clarity.
Recommendation	**Approve as modified.** Filename: "220428 CEPI-27 Re-org C402.1 and C402.2 (Modification).docx"
Vote	**Approve as modified:** 17-0-1 (CNV)
Recommendation Date	5/5/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

CEPI-27-21 (MODIFICATION 4/28/2022)

IECC®: SECTION C402, C402.1, C402.1.3, C402.1.3.1 (New), C402.1.3.2 (New), C402.1.3.3 (New), C402.1.3.4 (New), C402.1.3.5 (New), C402.1.3.6 (New), C402.1.4, C402.1.4.1, C402.1.4.1 (New), C402.1.4.1.1, C402.1.4.1.2, C402.1.4.1.3, C402.1.4.1.3 (New), C402.1.4.1.4 (New), C402.1.4.2, C402.2, C402.2.1, C402.2.1.1, C402.2.1.2, C402.2.1.3, C402.2.1.4, C402.2.1.5, C402.2.2, C402.2.3, C402.2.4, C402.2.4.1, C402.2.5, C402.2.6

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

Replace proposal as follows (clean version of modified proposal):

SECTION C402 BUILDING ENVELOPE REQUIREMENTS

C402.1 General. *Building thermal envelope* assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method of Section C402.1.3; the *U*-, *C*- and *F*-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.

2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.

3. Fenestration in building envelope assemblies shall comply with Section C402.4.

4. Air leakage of building envelope assemblies shall comply with Section C402.5.

5. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

~~Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.~~

C402.1.1 Low-energy buildings and greenhouses….(no change)

C402.1.1.1 Greenhouses…. (no change)

C402.1.2 Equipment buildings…. (no change)

NOTE TO STAFF: Renumber and re-organize the above unchanged sections and renumber remaining sections of this proposal to correlate with CEPI-34-21

C402.1.3 Insulation component *R*-value-based method. ~~*Building thermal envelope* opaque assemblies shall comply with the requirements of Sections C402.2 and C402.4 based on the *climate zone* specified in Chapter 3.~~ For opaque portions of the *building thermal envelope* intended to comply on an insulation component *R*-value basis, the *R*-values for *cavity insulation* and *continuous insulation* shall be not less than that specified in Table C402.1.3. ~~Where cavity insulation is installed in multiple layers, the cavity insulation *R*-values shall be summed to determine compliance with the cavity insulation *R*-value requirements. Where continuous insulation is installed in multiple layers, the continuous insulation *R*-values shall be summed to determine compliance with the continuous insulation *R*-value requirements. Cavity insulation *R*-values shall not be used to determine compliance with the continuous insulation *R*-value requirements in Table C402.1.3.~~ Commercial buildings or portions of commercial buildings enclosing *Group R* occupancies shall use the *R*-values from the "*Group R*" column of Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing occupancies other than *Group R* shall use the *R*-values from the "All other" column of Table C402.1.3.

C402.1.3.1 R-value of multi-layered insulation components. Where *cavity insulation* is installed in multiple layers, the *cavity insulation R*-values shall be summed to determine compliance with the *cavity insulation R*-value requirements. Where *continuous insulation* is installed in multiple layers, the *continuous insulation R*-values shall be summed to determine compliance with the *continuous insulation R*-value requirements. *Cavity insulation R*-values shall not be used to determine compliance with the *continuous insulation R*-value requirements.

C402.1.3.2 Area-weighted averaging of R-values. Area-weighted averaging shall not be permitted for R-value compliance.

Exception: For tapered above-deck roof insulation, compliance with the R-values required in Table C402.1.3 shall be permitted to be demonstrated by multiplying the rated R-value per inch of the insulation material by the average thickness of the roof insulation. The average thickness of the roof insulation shall equal the total volume of the roof insulation divided by the area of the roof.

C402.1.3.3 Mass walls and floors. Compliance with required minimum R-values for insulation components applied to mass walls and mass floors in accordance with Table C402.1.3 shall be permitted for assemblies complying with the following:

1. Where used as a component in the thermal envelope of a building, mass walls shall comply with one or more of the following:

a. Weigh not less than 35 pounds per square foot (171 kg/m^2) of wall surface area.

b. Weigh not less than 25 pounds per square foot (122 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).

c. Have a heat capacity greater than 7 Btu/ft^2 × °F (144 kJ/m^2 × K).

d. Have a heat capacity greater than 5 Btu/ft^2 × °F (103 kJ/m^2 × K), where the material weight is not more than 120 pcf (1900 kg/m^3).

2 Where used as a component of the thermal envelope of a building, the minimum weight of mass floors shall comply with provide one of the following:

a. 35 pounds per square foot (171 kg/m^2) of floor surface area.

b. 25 pounds per square foot (122 kg/m^2) of floor surface area where the material weight is not more than 120 pounds per cubic foot (1900 kg/m^3).

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor based method. ~~*Building thermal envelope* opaque assemblies shall meet the requirements of Sections C402.2 and C402.4 based on the climate zone specified in Chapter 3.~~ *Building thermal envelope* opaque assemblies intended to comply on an assembly *U*-, *C*- or *F*-factor basis shall have a *U*-, *C*- or *F*-factor not greater than that specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing *Group R* occupancies shall use the *U*-, *C*- or *F*-factor from the "*Group R*" column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than *Group R* shall use the *U*-, *C*- or *F*-factor from the "All other" column of Table C402.1.4

C402.1.4.1 Methods of determining U-, C-, and F-factors. Where assembly *U*-factors, *C*-factors and *F*-factors and calculation procedures are established in ANSI/ASHRAE/IESNA 90.1 Appendix A for opaque assemblies, such opaque assemblies shall be a compliance alternative provided they meet the criteria of Table C402.1.4 and the construction, excluding cladding system on walls, complies with the applicable construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative provided they meet the criteria of Table C402.1.4. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design. Air spaces used for assembly evaluations shall comply with Section C402.2.7.

~~**C402.1.4.1 Roof/ceiling assembly.** The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on construction materials used in the roof/ceiling assembly.~~

C402.1.4.1.1 Tapered, above-deck insulation based on thickness. For tapered, above-deck roof insulation, area-weighted U-factors of non-uniform insulation thickness shall be determined by an *approved* method. ~~Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the sloped roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value per inch (per mm) solely for *U*-factor compliance as prescribed in Section C402.1.4.~~

Exception: The area-weighted U-factor shall be permitted to be determined by using the inverse of the average R-value determined in accordance with the exception to Section C402.1.3.2.

C402.1.4.1.2 Suspended ceilings. Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling construction.

~~**C402.1.4.1.3 Joints staggered.** Continuous insulation board shall be installed in not less than two layers, and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.~~

C402.1.4.1.3 Concrete Masonry Units, Integral Insulation. Where determining compliance with Table C402.1.4, the *U*-factor of concrete masonry units with integral insulation shall be permitted to be used.

C402.1.4.1.4 Mass walls and floors. Compliance with required maximum U-factors for mass walls and mass floors in accordance with Table C402.1.4 shall be permitted for assemblies complying with Section C402.1.3.3.

C402.1.4.1.5 ~~C402.1.4.2~~ U-factor Thermal resistance of cold-formed steel walls. *U*-factors of walls with cold-formed steel studs shall be permitted to be determined in accordance with Equation 4-1.

$U = 1/[R_S + (ER)]$ **(Equation 4-1)**

where:

R_S = The cumulative *R*-value of the wall components along the path of heat transfer, excluding the *cavity insulation* and steel studs.

ER = The effective *R*-value of the *cavity insulation* with steel studs as specified in Table C402.1.4.2.

NOTE TO STAFF: Correlate C402.1.4.1.5 above with changes to existing Section C402.1.4.2 by CEPI-43-21.

C402.2 Specific ~~building thermal envelope~~ insulation and installation requirements. Insulation in *building thermal envelope* opaque assemblies shall be installed in accordance ~~comply~~ with Section C303.2 and Sections C402.2.1 through C402.2.7, or an approved design ~~and Table C402.1.3~~.

C402.2.1 Roof assembly. ~~The minimum thermal resistance (R-value) of the insulating material~~ Roof insulation materials shall be installed ~~either~~ between the roof framing, continuously above the ceiling framing, ~~or~~ continuously on or within the roof assembly, or in any *approved* combination thereof. Above-deck roof insulation, shall comply with Sections C402.2.1.1 through C402.2.1.3 ~~shall be as specified in Table C402.1.3, based on construction materials used in the roof assembly~~.

~~**C402.2.1.1 Tapered, above deck insulation based on thickness.** Where used as a component of a maximum roof/ceiling assembly R-value calculation, the sloped roof insulation shall use the average thickness in inches (mm) along with the material R-value per inch (per mm) solely for R-value compliance as prescribed in Section C402.1.3.~~

C402.2.1.1~~**C402.2.1.2**~~ **Minimum thickness, lowest point.** The ~~minimum~~ thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).

~~**C402.2.1.3 Suspended ceilings.** Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (R-value or U-factor) of the roof insulation in roof/ceiling construction.~~

C402.2.1.2~~**C402.2.1.4**~~ **Joints staggered.** *Continuous insulation* board located above the roof deck shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain, or scupper.

C402.2.1.3~~**C402.2.1.5**~~ **Skylight curbs.** Skylight curbs shall be insulated to the level of the above-deck roof ~~roofs with~~ insulation ~~entirely above the deck~~ or R-5, whichever is less.

C402.2.2 Above-grade walls. Above-grade wall insulation materials shall be installed between the wall framing, be integral to the wall assembly, be continuous on the wall assembly, or be any combination thereof. Where *continuous insulation* is layered on the exterior side of a wall assembly, the joints shall be staggered. ~~The minimum thermal resistance (*R*-value) of materials installed in the wall cavity between framing members and continuously on the walls shall be as specified in Table C402.1.3, based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C402.1.3 except as otherwise noted in the table. In determining compliance with Table C402.1.4, the use of the *U*-factor of concrete masonry units with integral insulation shall be permitted.~~

~~"Mass walls" where used as a component in the thermal envelope of a building shall comply with one of the following:~~

~~1. Weigh not less than 35 pounds per square foot (171 kg/m2) of wall surface area.~~

~~2. Weigh not less than 25 pounds per square foot (122 kg/m2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m3).~~

~~3. Have a heat capacity exceeding 7 Btu/ft2 × °F (144 kJ/m2 × K).~~

~~4. Have a heat capacity exceeding 5 Btu/ft2 × °F (103 kJ/m2 × K), where the material weight is not more than 120 pcf (1900 kg/m3).~~

C402.2.3 Floors over outdoor air or unconditioned space. Floor insulation shall be installed between floor framing, be integral to the floor assembly, be continuous on or under the floor assembly, or be any combination of these insulation methods. Where *continuous insulation* is layered on the exterior side of a floor assembly, the joints shall be staggered. ~~The thermal properties (component *R*-values or assembly *U*-, *C*- or *F*-factors) of floor assemblies over outdoor air or unconditioned space shall be as specified in Table C402.1.3 or C402.1.4 based on the construction materials used in the floor assembly.~~ Floor framing *cavity insulation* or structural slab insulation shall be installed to maintain permanent contact with the underside of the subfloor decking or structural slabs.

~~"Mass floors" where used as a component of the thermal envelope of a building shall provide one of the following weights:~~

~~1. 35 pounds per square foot (171 kg/m2) of floor surface area.~~

~~2. 25 pounds per square foot (122 kg/m2) of floor surface area where the material weight is not more than 120 pounds per cubic foot (1923 kg/m3).~~

Exceptions:

1. The floor framing *cavity insulation* or structural slab insulation shall be permitted to be installed in contact with the top side of sheathing or *continuous insulation* installed on the bottom side of floor assemblies. Floor framing or structural slab members at the perimeter of the floor assembly shall be insulated vertically for their full depth ~~where combined~~ with insulation equivalent to that required for the above-grade wall construction. ~~meets or exceeds the minimum *R*-value in Table C402.1.3 for "Metal framed" or "Wood framed and other" values for "Walls, above grade" and extends from the bottom to the top of all perimeter floor framing or floor assembly members.~~

2. Insulation applied to the underside of concrete floor slabs shall be permitted an airspace of not more than 1 inch (25 mm) where it turns up and is in contact with the underside of the floor under walls associated with the *building thermal envelope*.

C402.2.4 Slabs-on-grade. ~~The minimum thermal resistance (*R*-value) of the insulation for unheated or heated slab-on-grade floors designed in accordance with the *R*-value method of Section C402.1.3 shall be as specified in Table C402.1.3.~~

~~**C402.2.4.1 Insulation installation.**~~ Where installed, the perimeter insulation for slab-on-grade shall be placed on the outside of the foundation or on the inside of the foundation wall. For installations complying with Table C402.1.3, the ~~The~~ perimeter insulation shall extend downward from the top of the slab for the minimum distance shown in the table or to the top of the footing, whichever is less, or downward to not less than the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. ~~Insulation extending away from the building shall be protected by~~

~~pavement or by not less than 10 inches (254 mm) of soil~~. Where installed, full slab insulation shall be continuous under the entire area of the slab-on-grade floor, except at structural column locations and service penetrations. Insulation required at the heated slab perimeter shall not be required to extend below the bottom of the heated slab and shall be continuous with the full slab insulation.

Exception: Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.

C402.2.5 Below-grade walls. Below-grade wall insulation shall be installed between framing members, be integral to the wall assembly, be continuous on the wall assembly, or be any combination of these insulation methods. ~~The *C*-factor for the below-grade exterior walls shall be in accordance with Table C402.1.4. The *R*-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope shall be in accordance with Table C402.1.3. The *C*-factor or *R*-value required~~ For installations complying with Section C401.2.1, insulation shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below-grade wall, whichever is less.

C402.2.6 Insulation of radiant heating systems. *Radiant heating system* panels, and their associated components that are installed in interior or exterior assemblies, shall be insulated to an *R*-value of not less than R-3.5 on all surfaces not facing the space being heated. *Radiant heating system* panels that are installed in the *building thermal envelope* shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the *R*-value of insulation installed in the opaque assembly in which they are installed or the assembly shall comply with Section C402.1.4.

Exception: Heated slabs on grade insulated in accordance with Section C402.2.4 and Section C402.1.

C402.2.7 Airspaces. Where the *R*-value of an airspace is used for compliance in accordance with Section C402.1, the airspace shall be enclosed in an unventilated cavity constructed to minimize airflow into and out of the enclosed airspace. Airflow shall be deemed minimized where the enclosed airspace is located on the interior side of the continuous air barrier and is bounded on all sides by building components.

Exception: The thermal resistance of airspaces located on the exterior side of the continuous air barrier and adjacent to and behind the exterior wall-covering material shall be determined in accordance with ASTM C1363 modified with an airflow entering the bottom and exiting the top of the airspace at an air movement rate of not less than 70 mm/second.

NOTE TO STAFF: Correlate Section C402.2.7 with changes made by CEPI-48 as modified.

REASON [REVISED PROPOSAL]: This modified replacement proposal has the same objectives as the original proposal, but includes revisions to address numerous comments from a working group to improve this proposal. The original proposal with the various modifications and comments tracked is shown below.

Sections C402.1, C402.1.3, C402.1.4, and C402.2 are in need of improvement and better coordination to address redundancies and misplaced requirements related to R-value or U-factor compliance versus basic installation or application requirements. This proposal does not change any requirements, but places requirements in their proper location for clarity and ease of use. Section C402.2 is streamlined to focus on installation and application related matters pertaining to insulation installation. Consequently, R-value and U/C/F-factor compliance requirements are moved into Sections C402.1.3 or C402.1.4 where those requirements belong. In addition, redundant language is removed and existing text is editorially clarified where needed.

COST IMPACT: Will not increase or decrease cost of construction.

This proposal is a formatting/clarification change and does not change requirements.

ORIGINAL PROPOSAL WITH COMMENTS AND EDITS DOCUMENTED (FOR INFORMATION ONLY):

SECTION C402 BUILDING ENVELOPE REQUIREMENTS

C402.1 General. *Building thermal envelope* assemblies for buildings that are intended to comply with the code on a prescriptive basis in accordance with the compliance path described in Item 1 of Section C401.2.1 shall comply with the following:

1. The opaque portions of the *building thermal envelope* shall comply with the specific insulation requirements of Section C402.2 and the thermal requirements of either the *R*-value-based method of Section C402.1.3; the *U*-, *C*- and *F*-factor-based method of Section C402.1.4; or the component performance alternative of Section C402.1.5.

2. Roof solar reflectance and thermal emittance shall comply with Section C402.3.

3. Fenestration in building envelope assemblies shall comply with Section C402.4.

4. Air leakage of building envelope assemblies shall comply with Section C402.5.

5. Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.

Alternatively, where buildings have a vertical fenestration area or skylight area exceeding that allowed in Section C402.4, the building and *building thermal envelope* shall comply with Item 2 of Section C401.2.1 or Section C401.2.2.

~~Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.11.~~

C402.1.1 Low-energy buildings and greenhouses….(no change)

C402.1.1.1 Greenhouses…. (no change)

C402.1.2 Equipment buildings…. (no change)

C402.1.3 Insulation component *R*-value-based method. ~~*Building thermal envelope* opaque assemblies shall comply with the requirements of Sections C402.2 and C402.4 based on the *climate zone* specified in Chapter 3.~~ For opaque portions of the *building thermal envelope* intended to comply on an insulation component *R*-value basis, the *R*-values for *cavity insulation* and *continuous insulation* shall be not less than that specified in Table C402.1.3. ~~Where cavity insulation is installed in multiple layers, the cavity insulation *R*-values shall be summed to determine compliance with the cavity insulation *R*-value requirements. Where continuous insulation is installed in multiple layers, the continuous insulation *R*-values shall be summed to determine compliance with the continuous insulation *R*-value requirements. Cavity insulation *R*-values shall not be used to determine compliance with the continuous insulation *R*-value requirements in Table C402.1.3.~~ Commercial buildings or portions of commercial buildings enclosing *Group R* occupancies shall use the *R*-values from the "*Group R*" column of Table C402.1.3. Commercial buildings or portions of commercial buildings enclosing occupancies other than *Group R* shall use the *R*-values from the "All other" column of Table C402.1.3.

C402.1.3.1 R-value of multi-layered insulation components. Where *cavity insulation* is installed in multiple layers, the *cavity insulation R*-values shall be summed to determine compliance with the *cavity insulation R*-value requirements. Where *continuous insulation* is installed in multiple layers, the *continuous insulation R*-values shall be summed to determine compliance with the *continuous insulation R*-value requirements. *Cavity insulation R*-values shall not be used to determine compliance with the *continuous insulation R*-value requirements.

~~C402~~**~~2.1.3.2 Area-weighted averaging of R-values.~~** Area-weighted averaging shall not be permitted for R-value compliance.

Exception: For tapered above-deck roof insulation, compliance with the R-values required in Table C402.1.3 shall be permitted to be demonstrated by ~~the average R-value determined by~~ multiplying the rated R-value per inch of the insulation material by the average thickness of the roof insulation. The average thickness of the roof insulation shall equal the total volume of the roof insulation divided by the area of the roof.

~~**C402.1.3.3 Building materials and air spaces.** Building materials that are not insulation components complying with Chapter 3 shall be excluded from demonstrating compliance with the R-values of Table C402.1.3. Air spaces used to demonstrate compliance with Table C402.1.3 shall comply with Section C402.2.7.~~

~~**C402.1.3.4 Assembly construction.** Assembly constructions used for compliance with Table C402.1.3 shall be as described in ANSI/ASHRAE/IESNA 90.1 Appendix A.~~

~~**C402.1.3.5 Concrete masonry units, integral insulation.** The *R* value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C402.1.3 except as otherwise noted in the table.~~

C402.1.3.3 ~~C402.1.3.6~~ Mass walls and floors. Compliance with required minimum R-values for insulation components applied to "mass walls" and "mass floors" in accordance with Table C402.1.3 shall be permitted for assemblies complying with the following:

~~1. "Mass walls" where~~ Where used as a component in the thermal envelope of a building mass walls shall comply with one or more of the following:

a. Weigh not less than 35 pounds per square foot (171 kg/m^2) of wall surface area.

b. Weigh not less than 25 pounds per square foot (122 kg/m^2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m^3).

c. Have a heat capacity exceeding 7 Btu/ft^2 × °F (144 kJ/m^2 × K).

d. Have a heat capacity exceeding 5 Btu/ft^2 × °F (103 kJ/m^2 × K), where the material weight is not more than 120 pcf (1900 kg/m^3).

2. ~~"~~Mass floors~~" where~~ Where used as a component of the thermal envelope the minimum weight of mass floors shall comply with one of the following ~~weights~~:

a. 35 pounds per square foot (171 kg/m^2) of floor surface area.

b. 25 pounds per square foot (122 kg/m^2) of floor surface area where the material weight is not more than 120 pounds per cubic foot (~~1~~900 kg/m^3).

C402.1.4 Assembly *U*-factor, *C*-factor or *F*-factor based method. ~~*Building thermal envelope* opaque assemblies shall meet the requirements of Sections C402.2 and C402.4 based on the climate zone specified in Chapter 3.~~ *Building thermal envelope* opaque assemblies intended to comply on an assembly *U*-, *C*- or *F*-factor basis shall have a *U*-, *C*- or *F*-factor not greater than that specified in Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing *Group R* occupancies shall use the *U*-, *C*- or *F*-factor from the "*Group R*" column of Table C402.1.4. Commercial buildings or portions of commercial buildings enclosing occupancies other than *Group R* shall use the *U*-, *C*- or *F*-factor from the "All other" column of Table C402.1.4

~~**C402.1.4.1 Methods of determining U-, C-, and F-factors.** U-, C-, and F-factors for proposed *building thermal envelope* opaque assemblies shall be determined in accordance with pre-calculated values, testing, calculations, or modeling procedures established in ANSI/ASHRAE/IESNA 90.1 Appendix A. The R-value of insulation products used for assembly evaluations shall comply with Section C303.1.4. The thermal resistance of building materials used for assembly evaluations shall comply with values in ANSI/ASHRAE/IESNA 90.1 Appendix A or an *approved* source based *approved* test data. Air spaces used for assembly evaluations shall comply with Section C402.2.7.~~

C402.1.4.1 Methods of determining U-, C-, and F-factors. Where assembly *U*-factors, *C*-factors and *F*-factors and calculation procedures are established in ANSI/ASHRAE/IESNA 90.1 Appendix A for opaque assemblies, such opaque assemblies shall be a compliance alternative ~~where~~ provided they ~~those values~~ meet the criteria of Table C402.1.4 ~~this table,~~ and ~~provided that~~ the construction, excluding ~~the~~ cladding systems on walls, complies with the ~~appropriate~~ applicable construction details from ANSI/ASHRAE/ISNEA 90.1 Appendix A. Where *U*-factors have been established by testing in accordance with ASTM C1363, such opaque assemblies shall be a compliance alternative ~~where~~ provided they ~~those values~~ meet the criteria of Table C402.1.4 ~~this table~~. The *R*-value of continuous insulation shall be permitted to be added to or subtracted from the original tested design. Air spaces used for assembly evaluations shall comply with Section C402.2.7.

~~C402.1.4.1 Roof/ceiling assembly. The maximum roof/ceiling assembly *U*-factor shall not exceed that specified in Table C402.1.4 based on construction materials used in the roof/ceiling assembly.~~

C402.1.4.1.1 **Tapered, above-deck insulation based on thickness.** For tapered, above-deck roof insulation, ~~the~~ area-weighted U-factors of non-uniform insulation thickness shall be determined by an *approved* method~~by in accordance with accepted engineering practice~~. ~~Where used as a component of a maximum roof/ceiling assembly *U*-factor calculation, the sloped roof insulation *R*-value contribution to that calculation shall use the average thickness in inches (mm) along with the material *R*-value per inch (per mm) solely for *U*-factor compliance as prescribed in Section C402.1.4.~~

Exception: The area-weighted U-factor shall be permitted to be determined by using the inverse of the average R-value determined in accordance with the exception to Section C402.1.3.2.

C402.1.4.1.2 **Suspended ceilings.** Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the assembly *U*-factor of the roof/ceiling construction.

~~C402.1.4.1.3 Joints staggered. Continuous insulation board shall be installed in not less than two layers, and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain or scupper.~~

C402.1.4.1.3 **Concrete Masonry Units, Integral Insulation.** ~~In~~ Where determining compliance with Table C402.1.4, the *U*-factor of concrete masonry units with integral insulation shall be permitted to be used.

C402.1.4.1.4 **Mass walls and floors.** Compliance with required maximum U-factors for "mass walls" and "mass floors" in accordance with Table C402.1.4 shall be permitted for assemblies complying ~~the requirements of~~ with Section C402.1.3.6.

C402.1.4.1.5 ~~**C402.1.4.2**~~ **U-factor Thermal resistance of cold-formed steel walls.** *U*-factors of walls with cold-formed steel studs shall be permitted to be determined in accordance with Equation 4-1.

$$U = 1/[R_S + (ER)] \qquad \textbf{(Equation 4-1)}$$

where:

R_S = The cumulative *R*-value of the wall components along the path of heat transfer, excluding the *cavity insulation* and steel studs.

ER = The effective *R*-value of the *cavity insulation* with steel studs as specified in Table C402.1.4.2.

C402.2 Specific ~~building thermal envelope~~ insulation and installation requirements. Insulation in *building thermal envelope* opaque assemblies shall be installed in accordance~~comply~~ with Section C303.2 and Sections C402.2.1 through C402.2.7, or an approved design ~~and Table C402.1.3~~.

C402.2.1 Roof assembly

~~The minimum thermal resistance (R-value) of the insulating material~~ Roof insulation materials shall be installed ~~either~~ between the roof framing, continuously above the ceiling framing, ~~or~~ continuously on the roof assembly, or in any *approved* combination thereof.~~both~~, ~~and for above~~Above-deck roof insulation, shall comply with Sections C402.2.1.1 through C402.2.1.3 ~~as applicable~~ ~~be as specified in Table C402.1.3, based on construction materials used in the roof assembly~~.

~~**C402.2.1.1 Tapered, above deck insulation based on thickness**~~

~~Where used as a component of a maximum roof/ceiling assembly R-value calculation, the sloped roof insulation shall use the average thickness in inches (mm) along with the material R-value per inch (per mm) solely for R-value compliance as prescribed in Section C402.1.3.~~

C402.2.1.1~~C402.2.1.2~~ Minimum thickness, lowest point

The ~~minimum~~ thickness of above-deck roof insulation at its lowest point, gutter edge, roof drain or scupper, shall be not less than 1 inch (25 mm).

~~**C402.2.1.3 Suspended ceilings**~~

~~Insulation installed on suspended ceilings having removable ceiling tiles shall not be considered part of the minimum thermal resistance (R-value or U-factor) of the roof insulation in roof/ceiling construction.~~

C402.2.1.2~~C402.2.1.4~~ Joints staggered

Continuous insulation board located above the roof deck shall be installed in not less than two layers and the edge joints between each layer of insulation shall be staggered, except where insulation tapers to the roof deck at a gutter edge, roof drain, or scupper.

C402.2.1.3~~C402.2.1.5~~ Skylight curbs

Skylight curbs shall be insulated to the level of the above-deck roof ~~roofs with~~ insulation ~~entirely above the deck~~ or R-5, whichever is less.

C402.2.2 Above-grade walls. Above-grade wall insulation materials shall be installed between the wall framing, be integral to the wall assembly, be continuous on the wall assembly, or be any combination thereof ~~of these insulation methods~~. Where *continuous insulation* is layered on the exterior side of a wall assembly, the joints shall be staggered. ~~The minimum thermal resistance (*R*-value) of materials installed in the wall cavity between framing members and continuously on the walls shall be as specified in Table C402.1.3, based on framing type and construction materials used in the wall assembly. The *R*-value of integral insulation installed in concrete masonry units shall not be used in determining compliance with Table C402.1.3 except as otherwise noted in the table. In determining compliance with Table C402.1.4, the use of the *U*-factor of concrete masonry units with integral insulation shall be permitted.~~

~~"Mass walls" where used as a component in the thermal envelope of a building shall comply with one of the following:~~

~~1. Weigh not less than 35 pounds per square foot (171 kg/m2) of wall surface area.~~

~~2. Weigh not less than 25 pounds per square foot (122 kg/m2) of wall surface area where the material weight is not more than 120 pcf (1900 kg/m3).~~

~~3. Have a heat capacity exceeding 7 Btu/ft2 × °F (144 kJ/m2 × K).~~

~~4. Have a heat capacity exceeding 5 Btu/ft2 × °F (103 kJ/m2 × K), where the material weight is not more than 120 pcf (1900 kg/m3).~~

C402.2.3 Floors over outdoor air or unconditioned space. Floor insulation shall be installed between floor framing, be integral to the floor assembly, be continuous on or under the floor assembly, or be any combination of these insulation methods. Where *continuous insulation* is layered on the exterior side of a floor assembly, the joints shall be staggered. ~~The thermal properties (component *R*-values or assembly *U*-, *C*- or *F*-factors) of floor assemblies over outdoor air or unconditioned space shall be as specified in Table C402.1.3 or C402.1.4 based on the construction materials used in the floor assembly.~~ Floor framing *cavity insulation* or structural slab insulation shall be installed to maintain permanent contact with the underside of the subfloor decking or structural slabs.

Exceptions:

1. The floor framing *cavity insulation* or structural slab insulation shall be permitted to be in contact with the top side of sheathing or *continuous insulation* installed on the bottom side of floor assemblies where combined with insulation that ~~meets or exceeds the minimum~~ is not less than the applicable *R*-value in Table C402.1.3 for "Metal framed" or "Wood framed and other" values for "Walls, above grade" and which extends from the bottom to the top of all perimeter floor framing or floor assembly members.

2. Insulation applied to the underside of concrete floor slabs shall be permitted an airspace of not more than 1 inch (25 mm) where it turns up and is in contact with the underside of the floor under walls associated with the *building thermal envelope*.

C402.2.4 Slabs-on-grade. ~~The minimum thermal resistance (*R*-value) of the insulation for unheated or heated slab-on-grade floors designed in accordance with the *R*-value method of Section C402.1.3 shall be as specified in Table C402.1.3.~~

~~C402.2.4.1 Insulation installation.~~ ~~Where installed~~, For installations complying with Section C401.2.1 or an *approved* design, the perimeter insulation for slab-on-grade shall be placed on the outside of the foundation or on the inside of the foundation wall. The perimeter insulation shall extend downward from the top of the slab for the minimum distance shown in the table or to the top of the footing, whichever is less, or downward to not less than the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. ~~Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil~~. ~~Where installed, full~~ Full slab insulation shall be continuous under the entire area of the slab-on-grade floor, except at structural column locations and service penetrations. Insulation required at the heated slab perimeter shall not be required to extend below the bottom of the heated slab and shall be continuous with the full slab insulation.

Exception: Where the slab-on-grade floor is greater than 24 inches (61 mm) below the finished exterior grade, perimeter insulation is not required.

C402.2.5 Below-grade walls. Below-grade wall insulation shall be installed between framing members, be integral to the wall assembly, be continuous on the wall assembly, or be any combination of these insulation methods. ~~The *C*-factor for the below-grade exterior walls shall be in accordance with Table C402.1.4. The *R*-value of the insulating material installed continuously within or on the below-grade exterior walls of the building envelope shall be in accordance with Table C402.1.3. The installed insulation *C*-factor or *R*-value required~~ For installations complying with Section C401.2 (1) or an *approved* design, insulation shall extend to a depth of not less than 10 feet (3048 mm) below the outside finished ground level, or to the level of the lowest floor of the conditioned space enclosed by the below-grade wall, whichever is less.

C402.2.6 Insulation of radiant heating systems. *Radiant heating system* panels, and their associated components that are installed in interior or exterior assemblies, shall be insulated to an *R*-value of not less than R-3.5 on all surfaces not facing the space being heated. *Radiant heating system* panels that are installed in the *building thermal envelope* shall be separated from the exterior of the building or unconditioned or exempt spaces by not less than the *R*-value of insulation installed in the opaque assembly in which they are installed or the assembly shall comply with Section C402.1.4.

Exception: Heated slabs on grade insulated in accordance with Section C402.2.4 and Section C402.1.

C402.2.7 Airspaces. Where the *R*-value of an airspace is used for compliance in accordance with Section C402.1, the airspace shall be enclosed in an unventilated cavity constructed to minimize airflow into and out of the enclosed airspace. Airflow shall be deemed minimized where the enclosed airspace is located on the interior side of the continuous air barrier and is bounded on all sides by building components.

Exception: The thermal resistance of airspaces located on the exterior side of the continuous air barrier and adjacent to and behind the exterior wall-covering material shall be determined in accordance with ASTM C1363 modified with an airflow entering the bottom and exiting the top of the airspace at an air movement rate of not less than 70 mm/second.

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-030-21 Thermal Bridging Masonry
CDP ID #	87
Code	IECC CE
Code Section(s)	C402.1, C402.1.6 New Section y
Location	base
Proponent	Martha Vangeem martha.vangeem@gmail.com
Proposal Status	SC rev
Subcommittee	CE Envelope
Subcommittee Notes	**Reason Statement**: The ACI standard is not consistent with prior action on CECPI-4 and contains requirements and exemptions that are not consistent with CECPI-4.
Recommendation	**Disapprove**
Vote	**Disapprove:** 12-9-2 (CNV)
Recommendation Date	5/5/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-046-21 Component Performance Alternative
CDP ID #	549
Code	IECC CE
Code Section(s)	C402.1.5 New Section n
Location	base
Proponent	Helen Sanders helen.sanders@Technoform.com
Proposal Status	SC rev
Subcommittee	CE Envelope
Subcommittee Notes	**Reason Statement**: this proposal clarifies the equation for component trade off eliminating some confusion that existed.
Recommendation	**Approve as modified**. Filename: "C402.1.5 - CEPI 46 updated proposal.docx"
Vote	**Approve as modified:** 14-3-4 (CNV)
Recommendation Date	5/5/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

REPLACE ORIGINAL CEPI-46 PROPOSAL WITH THE FOLLOWING:

Component Performance Alternative CEPI-46

IECC®: C402.1.5

Proponents: Helen Sanders, Facade Tectonics Institute/Technoform North America, representing The Facade Tectonics Institute

2021 International Energy Conservation Code

Revise as follows

C402.1.5 Component performance alternative. Building envelope values and fenestration areas determined in accordance with Equation 4-2 shall be an alternative to compliance with the *U*-, *F*- and *C*-factors in Tables C402.1.4 and C402.4 and the maximum allowable fenestration areas in Section C402.4.1. *Fenestration* shall meet the applicable SHGC requirements of Section C402.4.3.

~~A + B + C + D + E □□Zero~~ **~~(Equation 4-2)~~**

~~where:~~

~~A = Sum of the (UA Dif) values for each distinct assembly type of the *building thermal envelope*, other than slabs on grade and below grade walls.~~

~~UA Dif = UA Proposed – UA Table.~~

~~UA Proposed = Proposed *U*-value × Area.~~

~~UA Table = (*U*-factor from Table C402.1.3, C402.1.4 or C402.4) × Area.~~

~~B = Sum of the (FL Dif) values for each distinct slab-on-grade perimeter condition of the *building thermal envelope*.~~

~~FL Dif = FL Proposed – FL Table.~~

~~FL Proposed = Proposed *F* value × Perimeter length.~~

~~FL Table = (*F*-factor specified in Table C402.1.4) × Perimeter length.~~

~~C = Sum of the (CA Dif) values for each distinct *below-grade wall* assembly type of the *building thermal envelope*.~~

~~CA Dif = CA Proposed – CA Table.~~

~~CA Proposed = Proposed *C* value × Area.~~

~~CA Table = (Maximum allowable *C* factor specified in Table C402.1.4) × Area.~~

~~Where the proposed vertical glazing area is less than or equal to the maximum vertical glazing area allowed by Section C402.4.1, the value of D (Excess Vertical Glazing Value) shall be zero. Otherwise:~~

~~D = (DA × UV) – (DA × U Wall), but not less than zero.~~

~~DA = (Proposed Vertical Glazing Area) – (Vertical Glazing Area allowed by Section C402.4.1).~~

~~UA Wall = Sum of the (UA Proposed) values for each opaque assembly of the exterior wall.~~

~~U Wall = Area-weighted average *U*-value of all above-grade wall assemblies.~~

~~UAV = Sum of the (UA Proposed) values for each vertical glazing assembly.~~

~~UV = UAV/total vertical glazing area.~~

~~Where the proposed skylight area is less than or equal to the skylight area allowed by Section C402.4.1, the value of E (Excess Skylight Value) shall be zero. Otherwise:~~

~~E = (EA × US) – (EA × U Roof), but not less than zero.~~

~~EA = (Proposed Skylight Area) – (Allowable Skylight Area as specified in Section C402.4.1).~~

~~U Roof = Area-weighted average *U*-value of all roof assemblies.~~

~~UAS = Sum of the (UA Proposed) values for each skylight assembly.~~

~~US = UAS/total skylight area.~~

$A_P + B_P + C_P \leq A_T + B_T + C_T - V_F - V_S$ **(Equation 4-2)**

where**:**

A_P = Sum of the (area x U-factor) for each proposed building thermal envelope assembly, other than slab-on-grade or below-grade wall assemblies
B_P = Sum of the (length x F-factor) for each proposed slab-on-grade edge condition
C_P = Sum of the (area x C-factor) for each proposed below-grade wall assembly
A_T = Sum of the (area x U-factor permitted by Tables C402.1.4 and C402.4) for each proposed building thermal envelope assembly, other than slab-on-grade or below-grade wall assemblies
B_T = Sum of the (length x F-factor permitted by Table C402.1.4 for each proposed slab-on-grade edge condition)
C_T = Sum of the (area x C-factor permitted by Table C402.1.4) for each proposed below-grade wall assembly

P_F = Maximum vertical fenestration area allowable by Section C402.4.1, C402.4.1.1, or C402.4.1.2
Q_F = Proposed vertical fenestration area
$R_F = Q_F - P_F$, but not less than zero (excess vertical fenestration area)
S_F = Area-weighted average U-factor permitted by Table C402.4 of all vertical fenestration assemblies
T_F = Area-weighted average U-factor permitted by Table C402.1.4 of all exterior opaque wall assemblies
$U_F = S_F - T_F$ (excess U-factor for excess vertical fenestration area)
$V_F = R_F \times U_F$ (excess UxA due to excess vertical fenestration area)

P_S = Maximum skylight area allowable by Section C402.1.4
Q_S = Actual skylight area
$R_S = Q_S - P_S$, but not less than zero (excess skylight area)
S_S = Area-weighted average U-factor permitted by Table C402.4 of all skylights
T_S = Area-weighted average U-factor permitted by Table C402.4.1 of all opaque roof assemblies
$U_S = S_S - T_S$ (excess U-factor for excess skylight area)
$V_S = R_S \times U_S$ (excess UxA due to excess skylight area)

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-004-21 Above Code Program backstop
CDP ID #	325
Code	IECC CE
Code Section(s)	C102.1.1 New Section n
Location	base
Proponent	William Fay bill@energyefficientcodes.org
Proposal Status	SC rev
Subcommittee	CE Model, Metrics
Subcommittee Notes	**Reason Statement**: Above code programs already need to meet C407.2 for energy efficiency. This proposal takes away flexibility in how those codes are developed. Perhaps the proposal could be clarified as to how this would apply to above code trade off programs.
Recommendation	**Disapprove**
Vote	**Disapprove:** 16-6-1 (CNV)
Recommendation Date	5/5/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-204-21 Performance Path backstop
CDP ID #	323
Code	IECC CE
Code Section(s)	C407.2 New Section n
Location	base
Proponent	William Fay bill@energyefficientcodes.org
Proposal Status	SC rev
Subcommittee	CE Model, Metrics
Subcommittee Notes	**Reason Statement**: The proposal does not save energy. It takes away flexibility of designers to optimize buildings.
Recommendation	**Disapprove**
Vote	**Disapprove:** 17-2-2 (CNV)
Recommendation Date	5/5/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-210-21 Performance fenestration backstop
CDP ID #	415
Code	IECC CE
Code Section(s)	C407.4.1(1) table New Section n
Location	base
Proponent	Helen Sanders helen.sanders@Technoform.com
Proposal Status	SC rev
Subcommittee	CE Model, Metrics
Subcommittee Notes	**Reason Statement**: The proposal does not save energy. It takes away flexibility of designers to optimize buildings. There are potential unintended consequences missed in exceptions.
Recommendation	**Disapprove**
Vote	**Disapprove:** 13-6-2 (CNV)
Recommendation Date	5/5/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-214-21 Commissioning Envelope
CDP ID #	219
Code	IECC CE
Code Section(s)	C408.1, C408.2, Chap 6 New Section n
Location	base
Proponent	Theresa Weston holtweston88@gmail.com
Proposal Status	SC rev
Subcommittee	CE Envelope
Subcommittee Notes	**Reason Statement**: The ASTM standard scope is much broader than energy provisions and it is unclear which tests are mandatory versus optional.
Recommendation	**Disapprove**
Vote	**Disapprove:** 11-2-4 (CNV)
Recommendation Date	5/5/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-241-21 Net zero backstop
CDP ID #	326
Code	IECC CE
Code Section(s)	CC103.1 New Section n
Location	base
Proponent	William Fay bill@energyefficientcodes.org
Proposal Status	SC rev
Subcommittee	CE Model, Metrics
Subcommittee Notes	**Reason Statement**: The proposal does not save energy. It takes away flexibility of designers to optimize buildings, and is not necessary in a net-zero energy appendix. Consistent with previous action on CEPI-4, 204, and 210.
Recommendation	**Disapprove**
Vote	**Disapprove:** 11-6-4 (CNV)
Recommendation Date	5/5/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CECPI-5-21 Zero Energy Building Appendix
CDP ID #	
Code	IECC CE
Code Section(s)	Appendix CC New Section n
Location	appendix
Proponent	Charles Eley
Proposal Status	SC rev
Subcommittee	CE Model, Metrics
Subcommittee Notes	Revises Appendix CC to align with CECPI-2-21 (Section 405.13), updates prescriptive minimum renewable energy requirements, revises offsite renewable energy procurement factors and makes miscellaneous simplifications and language cleanups.
Recommendation	Accept the attached proposal.
Vote	16-Accept, 0-Reject, 1-Abstain
Recommendation Date	5/2/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____✓_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

APPENDIX CC
ZERO ENERGY COMMERCIAL BUILDING PROVISIONS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

User note:

***About this chapter**: Appendix CC provides a model for applying new renewable energy generation when new buildings add electric load to the grid. This renewable energy will avoid the additional emissions that would otherwise occur from conventional power generation.*

SECTION CC101
GENERAL

CC101.1 Purpose. The purpose of this appendix is to supplement the *International Energy Conservation Code* and require renewable energy systems of adequate capacity to achieve net zero energy.

CC101.2 Scope. This appendix applies to new buildings that are addressed by the *International Energy Conservation Code*.

Exceptions:

1. Detached one- and two-family dwellings and townhouses as well as Group R-2 buildings three stories or less in height above grade plane, manufactured homes (mobile dwellings), and manufactured houses (modular dwellings).
2. Buildings that use neither electricity nor fossil fuel.

SECTION CC102
DEFINITIONS

CC102.1 Definitions. The definitions contained in this section supplement or modify the definitions in the International Energy Conservation Code.

ADJUSTED OFF-SITE RENEWABLE ENERGY. The amount of energy production from off-site renewable energy systems that may be used to offset building energy.

BUILDING ENERGY. All energy consumed at the building site as measured at the site boundary. Contributions from on- site or off-site renewable energy systems shall not be considered when determining the building energy.

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

DIRECT ACCESS TO WHOLESALE MARKET. An agreement by the owner and a renewable energy developer to purchase renewable energy from the wholesale market.

DIRECT OWNERSHIP. an *off-site renewable energy system* under the ownership or control of the building project owner.

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."

GREEN RETAIL PRICING. A program by the retail electricity provider to provide 100-percent renewable energy to the building project owner.

MINIMUM RENEWABLE ENERGY REQUIREMENT: the minimum amount of on-site or adjusted off-site renewable energy needed to comply with this appendix.

OFF-SITE RENEWABLE ENERGY SYSTEM. Renewable energy system which serves the building project and is not an *on-site renewable energy system*.

ON-SITE RENEWABLE ENERGY SYSTEM. Renewable energy systems located on any of the following:

1. the building,
2. the property upon which the building is located,
3. a property that shares a boundary with and is under the same ownership or control as the property on which the building is located, or
4. a property that is under the same ownership or control as the property on which the building is located and is separated only by a public right-of-way on which the building is located. .

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.

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

RENEWABLE ENERGY INVESTMENT FUND (REIF). A fund established by the local government or other entity to accept payment from building owners to construct or acquire qualifying renewable energy (along with RECs) on their behalf.

RENEWABLE ENERGY SYSTEM. Photovoltaic, solar thermal, geothermal energy extracted from hot fluid or steam, wind, or other approved renewable energy production systems used to generate energy.

SEMIHEATED SPACE. An enclosed space within a building that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h × ft2 of floor area but is not a conditioned space.

SECTION CC103
MINIMUM RENEWABLE ENERGY

CC103.1 Renewable energy. On-site renewable energy systems shall be installed, or adjusted off-site renewable energy shall be procured to meet the *minimum renewable energy requirement*.

(Equation CC-1)

$$RE_{onsite} + RE_{offsite} \geq RE_{min}$$

where:

RE_{onsite} = Annual site energy production from *on-site renewable energy systems* (see Section CC103.2), including installed *on-site renewable energy systems* for compliance with C405.13.1 and C406.5.

$RE_{offsite}$ = Adjusted annual energy production from *off-site renewable energy systems* that may be credited against the *minimum renewable energy requirement* (see Section CC103.3), including off-site renewable energy purchased for compliance with C405.13.2.

RE_{min} = *Minimum renewable energy requirement.*

When Section C401.2.1(1) is used for compliance with the *International Energy Conservation Code*, the *minimum renewable energy requirement* shall be determined by multiplying the gross *conditioned floor area* plus the gross semiheated floor area of the proposed building by the prescriptive renewable energy requirement from Table CC103.1. An area weighted average shall be used for mixed-use buildings.

When Section C401.2.1, Item 2 or Section C401.2.2 is used for compliance with the International Energy Conservation Code, the *minimum renewable energy requirement* shall be equal to the *building energy* as determined from energy simulations.

CC103.2 Calculation of on-site renewable energy. The annual energy production from *on-site renewable energy systems* shall be determined using ~~the PVWatts software or other~~ software *approved* by the code official.

CC103.2.1 Renewable energy certificates and other environmental attributes associated with the *on-site renewable energy system* shall be assigned to the initial and subsequent building owner(s) for a period of not less than 15 years. The building owner(s) may transfer renewable energy certificates to building tenants while they are occupying the building.

CC103.3 Off-site renewable energy. Off-site energy shall comply with Sections CC103.3.1 and CC103.3.2.

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

1. *Community renewables energy facility*
2. *Renewable energy investment fund*
3. *Financial renewable energy power purchase agreement*
4. *Direct ownership*
5. *Direct access to wholesale market*

6. *Green retail pricing*
7. Unbundled *Renewable Energy Certificates (RECs)*
8. *Physical renewable energy power purchase agreement*

TABLE CC103.1
PRESCRIPTIVE RENEWABLE ENERGY REQUIREMENT FOR BUILDING TYPES AND CLIMATES (kWh/ft²-yr)

	Building Area Type											
Climate Zone	Multifamily (R-2)	Healthcare/hospital (I-2)	Hotel/Motel (R-2)	Office (B)	Restaurant (A-2)	Retail (M)	School (E)	Warehouse (S)	Grocery Store (M)	Laboratory (B)	Assembly (A)	All others
0A	13	35	23	10	129	17	16	3	27	41	5	17
0B	12	34	22	10	123	17	15	3	26	40	5	16
1A	11	32	20	9	113	14	13	3	24	36	4	15
1B	11	32	20	9	118	15	14	3	24	37	5	15
2A	11	32	20	8	114	13	12	3	22	34	4	14
2B	11	30	18	8	108	12	11	3	22	33	4	13
3A	11	30	18	8	117	13	11	3	21	31	4	13
3B	10	29	18	8	110	12	10	3	20	31	4	13
3C	9	28	18	7	100	10	9	2	18	27	3	12
4A	12	31	18	8	123	15	11	6	21	32	4	14
4B	11	29	18	7	113	12	10	4	20	30	4	13
4C	10	28	17	7	111	13	10	4	18	28	3	13
5A	12	31	19	8	133	17	11	8	22	34	4	15
5B	11	29	18	8	125	14	11	5	21	31	4	14
5C	10	29	17	7	116	13	10	4	18	27	3	13
6A	14	33	20	10	151	20	13	11	26	39	5	17
6B	13	33	19	8	137	17	11	7	22	34	4	16
7	14	37	21	9	164	20	13	10	25	37	5	18
8	15	40	22	11	190	23	16	10	28	43	5	20

CC103.3.2 Requirements for all procurement methods. The following requirements shall apply to all off-site renewable energy procurement methods:

1. The building owner shall sign a legally binding contract or other approved agreement to procure qualifying off-site renewable energy.

2. The procurement contract shall have duration of not less than 15 years and shall be structured to survive a partial or full transfer of ownership of the property.

3. RECs and other environmental attributes associated with the procured off-site renewable energy shall meet all of the following requirements:.

   3.1 Are retained or retired by or on behalf of the property owner or tenant for a period of not less than 15 years.

   3.2 Are created within a 12-month period of the use of the REC; and

3.3 Are from a generating asset constructed no more than 5 years before the issuance of the certificate of occupancy.4. The generating source shall be a *renewable energy system*.

5. The generation source shall be located where the energy can be delivered to the building site by any of the following:

   5.1. By direct connection to the off-site renewable energy facility

   5.2. By the local utility or distribution entity

   5.3. By an interconnected electrical network where energy delivery capacity between the generator and the building site is available

6. Records on power sent to or purchased by the building project shall be retained by the building owner and made available for inspection by the code official upon request.

CC103.3.3 Adjusted off-site renewable energy. The process for calculating the adjusted off-site renewable energy is shown in Equation CC-2.

(Equation CC-2)

$$RE_{offsite} = \sum_{i-1}^{n} PF_i \times RE_i = PF_1 \times RE_1 + PF_2 \times RE_2 + \ldots + PF_n \times RE_n$$

where:

$RE_{offsite}$ = Adjusted off-site renewable energy.

PF_i = Procurement factor for the i^{th} renewable energy procurement method per Section CC103.3.3.1.

RE_i = Annual energy production for the i^{th} renewable energy procurement method.

n = The number of renewable energy procurement methods considered.

CC103.3.3.1 Procurement Factors. When installed on-site renewable energy capacity is 7.5 W/ft^2 of roof area or greater, the procurement factor is 1.00, otherwise, the procurement factor is 0.75, except for unbundled renewable energy certificates which shall have a procurement factor of 0.20. A procurement factor of 1.0 may also be used when the conditions of exceptions 1, 2, or 3 to C405.13.1 are satisfied.

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-064-21 HVAC operable opening exception
CDP ID #	158
Code	IECC CE
Code Section(s)	C402.5.11 New Section n
Location	base
Proponent	Glory O'Brien glory.obrien@westernmechanicalsolutions.com
Proposal Status	SC rev
Subcommittee	CE HVACR & WH
Subcommittee Notes	• Proponent not present • Addresses same code section as CEPI – 65. • John Bade – proposal would add exception for evaporative cooling. • Subcommittee action on CEPI-65 covers what this proposal would have done. No longer needed.
Recommendation	Disapprove Reason: this proposal is no longer needed since intent has been covered already in previous committee action of CEPI-65 approval as modified.
Vote	Motion to Disapprove passed 17-0-0
Recommendation Date	4/14/2022
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee __X_____
Consensus Committee	
Committee Response	

Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-065-21 Operable opening interlocking
CDP ID #	509
Code	IECC CE
Code Section(s)	C402.5.11, C402.5.11.1, C403.14 New Section n
Location	base
Proponent	Lisa Rosenow lrosenow@evergreen-tech.net
Proposal Status	SC rev
Subcommittee	CE HVACR & WH
• Subcommittee Notes	• HVACR SC worked with the proponent to expand and improve the proposal. The Envelope Subcommittee reviewed it, and changes were incorporated. The As Modified proposal is a reorganization of the original proposal but keeps the same intent. The proposal also meets the intent of CEPI-64. • The proposal moves the requirements for shutting off heating and cooling when operable openings are open from Section C402 Building Envelope Requirements to Section 403 Building Mechanical Systems. Mechanical designers are responsible for meeting the requirements of the section, so there is no reason for it to be in C402. Since these are HVAC controls that fall under C403.4 Heating and cooling system controls, the existing reference to C402 in C403.14 has been deleted and all the text now appears in C404.3 • Committee discussion around the term “overhead door” in the exception language and the need to use a different term to expand application, with subsequent revision to “operable openings”. • This is an expansion of scope, since current code only has requirements for openings > 40ft2 and this proposal would pull in other openings /doors. Main application is to doors in hotels and residential occupancies, private patios, etc. • Committee discussion around how heating shutoff in northern climates could be an issue for freeze protection. Committee clarification that code proposal does not require turning off heating and there is an option to reset temperature to 55F. This requirement has been in 90.1 for a while, have engaged with cold climate engineers and this hasn’t been a concern • Committee support for inclusion of doors with air curtains in the exception, subsequent language revisions to reflect this exception • The requirement is made mandatory by adding a reference in Table C407.2 Requirements for Total Building Performance.

	• The three existing exceptions have been kept, and new ones added. The exceptions for Building entrances with automatic closing devices, operable openings serving enclosed spaces without a thermostat or temperature sensor, and alterations where walls would have to be opened solely for the purpose of adding the controls and where approved by the code official are found in ASHRAE 90.1, but have been modified to improve the text or stringency.
Recommendation	Approve as modified, see attached modification Reason: proposal supports increased energy efficiency around the building envelope though operable openings
Vote	Motion to Approve As Modified passed 16-0-1
Recommendation Date	4/14/2022
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee___X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

CEPI-65-21 as modified

IECC®: C402.5.11, C402.5.11.1, C403.14

Proponents:

Lisa Rosenow, representing Self (lrosenow@evergreen-tech.net); Kevin Rose, representing Northwest Energy Efficiency Alliance(NEEA) (krose@neea.org); Glory O'Brien, representing Western Mechanical Solutions (glory.obrien@westernmechanicalsolutions.com)

2021 International Energy Conservation Code

Delete without substitution:

~~**C402.5.11 Operable openings interlocking.**~~
~~Where occupancies utilize operable openings to the outdoors that are larger than 40 square feet (3.7 m2) in area, such openings shall be interlocked with the heating and cooling system so as to raise the cooling setpoint to 90°F (32°C) and lower the heating setpoint to 55°F (13°C) whenever the operable opening is open. The change in heating and cooling setpoints shall occur within 10 minutes of opening the operable opening.~~

~~**Exceptions:**~~

1. ~~Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.~~
2. ~~Warehouses that utilize overhead doors for the function of the occupancy, where approved by the code official.~~
3. ~~The first entrance doors where located in the exterior wall and are part of a vestibule system.~~

~~**C403.14 Operable opening interlocking controls**~~

~~The heating and cooling systems shall have controls that will interlock these mechanical systems to the set temperatures of 90ºF (32QC) for cooling and 55QF (12.7QC) for heating when the conditions of Section C402.5.11 exist. The controls shall configure to shut off the systems entirely when the outdoor temperatures are below 90QF (32QC) or above 55QF (12.7QC).~~

Add new text as follows:

C403.4.6 HVAC system controls for operable openings to the outdoors

All doors from a *conditioned space* to the outdoors and all other operable openings from a *conditioned space* to the outdoors that are larger than 40 square feet (3.7 m^2) when fully open, shall have *automatic* controls interlocked with the heating and cooling system. The controls shall be configured to do the following within 5 minutes of opening:

1. Disable mechanical heating to the *zone* or reset the space heating temperature setpoint to 55°F (12.7°C) or less.
2. Disable mechanical cooling to the *zone* or reset the space cooling temperature setpoint to 90°F (32°C) or more. Mechanical cooling can remain enabled if the outdoor air temperature is below the space temperature.

Exceptions:

1. *Building entrances* with *automatic* closing devices
2. Emergency exits with an *automatic* alarm that sounds when open

3. Operable openings and doors serving *enclosed spaces* without a *thermostat* or HVAC temperature sensor
4. Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy
5. Warehouses that utilize operable openings for the function of the occupancy where approved by the code official
6. The first entrance doors where located in the exterior wall and are part of a vestibule system
7. Operable openings into spaces served by radiant heating and cooling systems
8. *Alterations* where walls would have to be opened solely for the purpose of meeting this requirement and where approved.
9. Doors served by *air curtains* meeting the requirements of Section C402.5.9

Revise as follows:

TABLE C407.2
REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
Envelope	
C402.5	Air leakage—thermal envelope
Mechanical	
C403.1.1	Calculation of heating and cooling loads
C403.1.2	Data centers
C403.2	System design
C403.3	Heating and cooling equipment efficiencies
C403.4.1~~, except C403.4.3, C403.4.4 and C403.4.5~~	~~Heating and cooling system~~ Thermostatic controls
C403.4.2	Off-hour controls
C403.4.6	HVAC system controls for operable openings to the outdoors
C403.5.5	Economizer fault detection and diagnostics
C403.7, except C403.7.4.1	Ventilation and exhaust systems
C403.8, except C403.8.6	Fan and fan controls
C403.9	Large-diameter ceiling fans
C403.11, except C403.11.3	Refrigeration equipment performance
C403.12	Construction of HVAC system elements
C403.13	Mechanical systems located outside of the building thermal envelope
C404	Service water heating
C405, except C405.3	Electrical power and lighting systems
C408	Maintenance information and system commisioning

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

Reason Statement:

The proposal moves the requirements for shutting off heating and cooling when operable openings are open from Section C402 *Building Envelope Requirements* to Section 403 *Building Mechanical Systems.* Mechanical

designers are responsible for meeting the requirements of the section, so there is no reason for it to be in C402. Since these are HVAC controls that fall under C403.4 *Heating and cooling system controls*, the existing reference to C402 in C403.14 has been deleted and all the text now appears in C404.3

The new text allows the option to either disable mechanical heating or cooling or to raise the cooling setpoint and lower the heating setpoint. The existing language only allows the setpoint change. This will allow evaporative cooling to continue to operate.

Stringency is increased by adding doors, though many doors will fall under the exceptions, and reducing the time allowed for execution from ten minutes to five minutes. The requirement is made mandatory by adding a reference in Table C407.2 *Requirements for Total Building Performance*.

The three existing exceptions have been kept, and new ones added. The exceptions for Building entrances with automatic closing devices, operable openings serving enclosed spaces without a thermostat or temperature sensor, and alterations where walls would have to be opened solely for the purpose of adding the controls and where approved by the code official are found in ASHRAE 90.1, but have been modified to improve the text or stringency.

Cost Impact:

The code change proposal will increase the cost of construction. Requirements for interlocking door controls were added to ASHRAE 90.1 in the 2013 edition with addendum ba.. The foreword to the first public review of the addendum stated:

> When a space with operable windows has non-integrated mechanical heating and cooling, it is likely that annual HVAC energy will be increased when compared to the same space without operable windows. This can be attributed to operable windows being left open when conditions are not favorable, resulting in high infiltration loads on the HVAC system. There are many reasons why windows are opened when conditions are not favorable:
>
> 1. Occupant wants more fresh air and is inconsiderate or unaware of the energy penalty of opening the window when indoor/outdoor conditions are not favorable. This is particularly likely when the HVAC system has sufficient capacity to maintain the space indoor temperature at setpoint despite the increased infiltration load.
> 2. Occupant does not have sufficient information regarding the indoor air temperature, outdoor air temperature, or HVAC mode of operation to properly determine if opening the window will reduce or increase energy use.
> 3. Occupant opened the window during favorable conditions but left the room while the window was open. During their time away from the space, the conditions transitioned to unfavorable

Public commenters to the first public review of addendum ba were concerned that the cost of controls, estimated to be $250 to $500 per opening, would discourage the use of operable windows and suggested the requirement be limited to doors..

Reviewers should note that many doors are excepted, including building entrances for the public with automatic closers, the exterior doors of a vestibule system, doors that are alarmed, and doors served by an air curtain system.

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CECPI-007-21 Interior LPD Committee Proposal
CDP ID #	
Code	IECC CE
Code Section(s)	New Section n
Location	base
Proponent	Electrical Power, Lighting, Renewables Subcommittee
Proposal Status	SC rev
Subcommittee	CE Elec, Light
Subcommittee Notes	
Recommendation	
Vote	Approved as modified 15-1-1
Recommendation Date	5/9/22
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-171-21 Façade lighting
CDP ID #	85
Code	IECC CE
Code Section(s)	C405.2.7.2 New Section n
Location	base
Proponent	Glenn Heinmiller glenn@lampartners.com
Proposal Status	SC rev
Subcommittee	CE Elec, Light
Subcommittee Notes	Reason: Does not account for lighting operations for businesses/ organizations that may operate after 12:00 am.
Recommendation	DISAPPROVE
Vote	9 - 8 – 1
Recommendation Date	May 9, 2022
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-172-21 Lighting Business closing
CDP ID #	89
Code	IECC CE
Code Section(s)	C405.2.7.2, C405.2.7.3 New Section n
Location	base
Proponent	Glenn Heinmiller glenn@lampartners.com
Proposal Status	SC rev
Subcommittee	CE Elec, Light
Subcommittee Notes	Reason: Adds clarification to the requirement that it applies to all occupancies (businesses and non-business [e.g., school or church, etc.]).
Recommendation	APPROVE AS SUBMITTED
Vote	15-2-2
Recommendation Date	May 9, 2022
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-173-21 Lighting Parking Lot Activity Sensors
CDP ID #	343
Code	IECC CE
Code Section(s)	C405.2.7.3 New Section n
Location	base
Proponent	Mike Kennedy mikekennedy@energysims.com
Proposal Status	SC rev
Subcommittee	CE Elec, Light
Subcommittee Notes	Reason: Proposal aligns the code with efficacy improvements with LED lighting and is cost effective with simple payback under 5 years.
Recommendation	APPROVE AS SUBMITTED
Vote	14 - 2 - 3
Recommendation Date	May 9, 2022
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-174-21 Lighting setback
CDP ID #	286
Code	IECC CE
Code Section(s)	C405.2.7.3 New Section n
Location	base
Proponent	Steven Rosenstock srosenstock@eei.org
Proposal Status	SC rev
Subcommittee	CE Elec, Light
Subcommittee Notes	Reason: Creates unnecessary cost and complexity.
Recommendation	DISAPPROVE
Vote	16 - 3 - 1
Recommendation Date	May 9, 2022
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code
Code Change Proposal Tracking Sheet

Proposal #	CEPI-186-21 Lighting system performance alternate compliance
CDP ID #	138
Code	IECC CE
Code Section(s)	C405.4 New Section y
Location	base
Proponent	Jeremy Williams jeremy.williams@ee.doe.gov
Proposal Status	SC rev
Subcommittee	CE Elec, Light
Subcommittee Notes	
Recommendation	disapprove
Vote	16-1-2
Recommendation Date	May 9, 2022
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	

International Energy Conservation Code

Code Change Proposal Tracking Sheet

Proposal #	CEPI-189-21 Lighting exterior updates
CDP ID #	135
Code	IECC CE
Code Section(s)	C405.5.1, TABLE C405.5.2(1), TABLE C405.5.2(3) New Section n
Location	base
Proponent	Jeremy Williams jeremy.williams@ee.doe.gov
Proposal Status	SC rev
Subcommittee	CE Elec, Light
Subcommittee Notes	Reason: Improves exterior lighting efficiency based on LED efficiency improvements and aligns with ASHRAE/IES Standard 90.1.
Recommendation	APPROVE AS SUBMITTED.
Vote	17 - 0 - 1
Recommendation Date	May 9, 2022
Next Step	To Subcommittee_____ To Advisory Group_____ To Consensus Committee_____X_____
Consensus Committee	
Committee Response	
Vote	Affirmative_____ Negative_____ Table_____ To Subcommittee_____
Date	