

CE235-19

IECC: SECTION C406, C406.1, Table C406.1(1) (New), Table C406.1(2) (New), Table C406.1(3) (New), Table C406.1(4) (New), Table C406.1(5) (New), C406.1.1, C406.2, C 406.2.1 (New), C 406.2.2 (New), C 406.2.3 (New), C 406.2.4 (New), C406.5. (New), C406.5, C 406.5.2 (New), C406.7 (New), C406.7, C406.7.1, C406.7.3 (New), C406.7.4 (New), C406.10 (New)

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2018 International Energy Conservation Code

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

Revise as follows:

C406.1 Requirements. ~~Buildings shall comply~~ New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building. Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits may also be as calculated in accordance the relevant subsection of C406. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

1. More efficient HVAC performance in accordance with Section C406.2.
2. Reduced lighting power in accordance with Section C406.3.
3. Enhanced lighting controls in accordance with Section C406.4.
4. On-site supply of renewable energy in accordance with Section C406.5.
5. Provision of a dedicated outdoor air system for certain HVAC equipment in accordance with Section C406.6.
6. High-efficiency service water heating in accordance with Section C406.7.
7. Enhanced envelope performance in accordance with Section C406.8.
8. Reduced air infiltration in accordance with Section C406.9
9. Extra daylit area with *daylight responsive controls* in accordance with Section C406.10

Add new text as follows:

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

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
<u>C406.2.1: 5% Heating Eff Imprv.</u>	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
<u>C406.2.2: 5% Cooling Eff Imprv.</u>	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
<u>C406.2.3: 10 % Heating Eff Imprv.</u>	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	2	1	1	2	2	NA	1
<u>C406.2.4: 10 % Cooling Eff Imprv.</u>	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
<u>C406.3: Reduced Light Power</u>	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
<u>C406.4: Enh. Digital Light Ctrl</u>	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
<u>C406.5.1: On-site Renewable Egy.</u>	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
<u>C406.6 : Dedicated OA Sys (DOAS)</u>	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3

C406.7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: Enhanced Envelope Perf	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Reduced Air Infiltration	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6
C406.10 Extra Daylit Area	7	6	7	7	6	7	8	6	7	6	5	6	6	5	6	5	4

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

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406 .2.2: 5% Cooling Eff Imprv.	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406 .2.4: 10 % Cooling Eff Imprv.	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406 .3: Reduced Light Power	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406 .7.2: Recovered/Renew SWH	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406 .7.3: Eff fossil fuel SWH	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406 .7.4: Heat Pump SWH	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406 .8: Enhanced Envelope Perf	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406 .9: Reduced Air Infiltration	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3
C406.10 Extra Daylit Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406 .2.2: 5% Cooling Eff Imprv.	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406 .2.4: 10 % Cooling Eff Imprv.	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406 .3: Reduced Light Power	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406 .4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406 .5.1: On-site Renewable Egy.	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406 .6 : Dedicated OA Sys (DOAS)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.2: Recovered/Renew SWH ^a	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406 .7.3: Eff fossil fuel SWH ^a	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406 .7.4: Heat Pump SWH ^a	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1

C406 .8: Enhanced Envelope Perf	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406 .9: Reduced Air Infiltration	1	1	1	2	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3	
C406.10 Extra Daylit Area	2	1	2	2	3	3	3	3	3	2	3	3	3	1	2	NA	NA

^a for schools with full service kitchens or showers

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

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406 .2.2: 5% Cooling Eff Imprv.	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406 .2.4: 10 % Cooling Eff Imprv.	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406 .3: Reduced Light Power	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406 .4: Enh. Digital Light Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406 .7.2: Recovered/Renew SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.3: Eff fossil fuel SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .7.4: Heat Pump SWH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406 .8: Enhanced Envelope Perf	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406 .9: Reduced Air Infiltration	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3
C406.10 Extra Daylit Area	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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

Sub-section / Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6 A	6 B	7	8
C406 .2.1: 5% Heating Eff Imprv.	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406 .2.2: 5% Cooling Eff Imprv.	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406 .2.3: 10 % Heating Eff Imprv.	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406 .2.4: 10 % Cooling Eff Imprv.	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406 .3: Reduced Light Power	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406 .4: Enh. Digital Light Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406 .5.1: On-site Renewable Egy.	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406 .6 : Dedicated OA Sys (DOAS)	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406 .7.2: Recovered/Renew SWH ^b	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406 .7.3: Eff fossil fuel SWH ^b	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406 .7.4: Heat Pump SWH ^b	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406 .8: Enhanced Envelope Perf	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406 .9: Reduced Air Infiltration	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4

C406.10 Extra Daylit Area	3	2	3	3	3	3	4	3	3	3	3	3	2	3	2	NA
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a Other occupancy groups include all Groups except for Groups B, R, I, E, and M.

b for occupancy groups listed in C406 .7.1.

Revise as follows:

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

Exception: Previously occupied tenant spaces that comply with this code in accordance with Section C501.

C406.2 More efficient HVAC equipment performance. Equipment shall exceed the minimum efficiency requirements listed in Tables C403.3.2(1) through C403.3.2(7) by 10 percent, in addition to the requirements of Section C403. Where multiple performance requirements are provided, the equipment shall exceed all requirements by 10 percent. 9). Variable refrigerant flow systems shall exceed listed in the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent. 90.1. in accordance with Sections C406 .2.1, C406 .2.2, C406 .2.3 or C406 .2.4. Equipment shall also meet applicable requirements of Section C403. Energy efficiency credits for heating shall be selected from C406 .2.1 or C406.2.3 and energy efficiency credits for cooling shall be selected from C406.2.2 or C406.2.4. Selected credits shall include a heating or cooling energy efficiency credit or both. Equipment not listed in Tables C403.3.2(1) through C403.3.2(7-9) and Variable refrigerant flow systems not listed in the energy efficiency provisions of ANSI/ASHRAE/IES 90 .1 shall be limited to 10 percent of the total building system capacity. capacity for heating equipment where selecting C406.2.1 or C406.2.3 and cooling equipment where selecting C406.2.2 or C406.2.4. .

Add new text as follows:

C 406.2.1 Five percent heating efficiency improvement. Equipment shall exceed the minimum heating efficiency requirements by 5 percent.

C 406.2.2 Five percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 5 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C 406.2.3 Ten percent heating efficiency improvement Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C 406.2.4 Ten percent cooling efficiency improvement Equipment shall exceed the minimum cooling and heat rejection efficiency requirements by 10 percent. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

C406.5. On-site renewable Buildings shall comply with Section C406 .5.1 or C406 .5.2.

Revise as follows:

C ~~C406.5~~ C406.5.1 On-site-Basic renewable energy- credit The total minimum ratings of on-site renewable energy systems not including systems used for credits under Section C406.7.2 shall be one of the following:

1. Not less than ~~4.74~~0.86 Btu/h per square foot (~~5.4~~2.7 W/m²) or ~~0.50~~0.25 watts per square foot

(5.4-2.7 W/m²) of conditioned floor area.

2. Not less than ~~3~~2 percent of the annual energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

Add new text as follows:

C 406.5.2 Enhanced Renewable Credits. Where the total minimum ratings of on-site renewable energy systems exceeds the rating in C406 .5.1(1), additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

$$AEEC_{RRa} = AEEC_{2.5} \times RRa / RR_1 \text{ (Equation 4-13)}$$

Where:

AEEC_{RRa} = C406 .5.2 additional energy efficiency credits

RRa = actual total minimum ratings of on-site renewable energy systems in Btu/h, watts per square foot or W/m²

RR1 = minimum ratings of on-site renewable energy systems required by C406 .5.1(1) in Btu/h, watts per square foot or W/m²

AEEC_{2.5} = C406 .5.1 credits from Tables C406 .1(1) through C406 .1(5)

C406.7 Reduced energy use in service water heating. Buildings shall comply with Sections C406.7.1 and either C406 .7.2, C406 .7.3 or C406 .7.4.

Revise as follows:

~~C406.7 C406.7.1 Reduced energy use in service water heating. Building Type~~ Buildings shall be of the following types to use this compliance method To qualify for this credit, the building shall contain one of the following use groups and the additional energy efficiency credit shall be prorated by conditioned floor area of the portion of the building comprised of the following use groups:

1. *Group R-1: Boarding houses, hotels or motels.*
2. *Group I-2: Hospitals, psychiatric hospitals and nursing homes.*
3. *Group A-2: Restaurants and banquet halls or buildings containing food preparation areas.*
4. *Group F: Laundries.*
5. *Group R-2.*
6. *Group A-3: Health clubs and spas.*
7. Group E: Schools with full-service kitchens or locker rooms with showers.
8. Buildings showing a service hot water load of 10 percent or more of total building energy loads, as shown with an energy analysis as described in Section C407.

~~C406.7.1 C406.7.2 Load fraction. 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 ~~60~~30 percent of the building's annual hot water requirements, or sized to provide ~~100~~70 percent of the building's annual hot water requirements if the building ~~shall otherwise be required to~~ comply with Section C403.9.5:

1. Waste heat recovery from service hot water, heat-recovery chillers, building equipment, or process equipment.
2. *On-site renewable energy water-heating systems.*

Add new text as follows:

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

C406.7.4 Heat pump water heater. Where electric resistance water heaters are allowed, all service hot water system heating requirements shall be met using heat pump technology with a combined input-capacity-weighted-average EF of 3.0. Air-source heat pump water heaters shall not draw conditioned air from within the building, except exhaust air that would otherwise be exhausted to the exterior.

C406.10 Extra Daylit Area Building shall not use the energy efficiency credits for Section C406.7, enhanced lighting control, and shall provide continuous dimming daylight responsive controls for 150 percent of the area required to have daylight responsive controls in toplit zones and sidelit zones in Section C405.2.3 or as required by Section C402.4.1.1. Toplit and sidelit zones as defined in Sections C405.2.3.2 and C405.2.3.3 shall be controlled separately from adjacent daylight zones.

Reason:

C406 Credits for Added Daylighting Area

This proposal builds on top of a proposal that assigns energy efficiency credits to each option in Section C406 (CE218-19). For clarity, that entire base proposal is included here with additional provisions and table row additions that provide an additional energy efficiency credit option when extra daylit area included in the building. As part of the comprehensive analysis of C406 measures that is listed in the bibliography, the relative energy cost savings for each measure was determined. Then points or credits were assigned to each measure by climate zone and building type based on one point per 0.25% building cost savings.

This proposal allows credit for increased daylighting area in Section C406 where extra efficiency options are required and includes the following:

- Adds provisions to increase the daylit area to 150% of prescriptively required area.
- Add rows with appropriate credits to the 5 occupancy group tables for this provision.

The current daylighting requirements apply only to what are considered primary daylit zones. These are toplit and sidelit zones as defined in Sections C405.2.3.2 and C405.2.3.3. This measure extends the primary daylit area by adding 50% more daylit area.

Expanding the daylit control area (Section C406.10) saves energy by reducing lighting power when daylighting is available in these areas. This measure provides more flexibility to building designers when it is added to the energy efficiency credit choices. It specifically provides an expansion in the daylit area, which allows lighting to be reduced in a larger portion of the building with daylight responsive controls. The proposal requires separate control of the luminaire light levels in primary and secondary daylit areas.

Bibliography: Hart, R., R. Nambiar, M. Tyler, M., Y. Xie, and J. Zhang. "Relative Credits for Extra Efficiency Measures: Technical Brief." Pacific Northwest National Laboratory (PNNL), Richland, WA (US), January 2019.

Cost Impact: The code change proposal will not increase or decrease the cost of construction. The current proposal does not require more investment, but rather expands existing options permitted under the 2018 IECC. The intention is to identify additional options to increase flexibility and more effectively utilize new technologies and construction practices. There is not expected to be an increased cost, as this simply increases the options for C406 beyond what is included in current code. In some cases, costs may be reduced, as the outlined approach provides partial credit for selected items as well as credit for items that may have previously been included in the building design without credit. Costs, and cost effectiveness, are not evaluated for individual measures due to the vast number of potential combinations amongst building types, climates, and selected options. Actual costs will vary based on the items selected by the building designer—architects, engineers, and other involved trades—based on the needs and goals of the individual project.

Proposal # 5107

CE235-19