

C406 Points Option

IECC: SECTION C406 (New), C406.1 (New), **C406.1** (New), C406.1.1 (New), C406.2 (New), C406.3, C406.5, C406.7, C406.7.1

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2018 International Energy Conservation Code

Revise as follows:

SECTION C406 ADDITIONAL EFFICIENCY PACKAGE OPTIONS REQUIREMENTS

~~C406.1 Requirements.~~ **Additional energy efficiency credit requirements.** Buildings shall comply 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.~~

New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5). 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.

Add new text as follows:

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

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1
C406.2.2: 5% Cooling	6	6	5	5	4	4	3	3	3	2	2	2	1	2	2	2	1
C406.2.3: 10% Heating	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	2	1	1	2	2	NA	1
C406.2.4: 10% Cooling	11	12	10	9	7	7	6	5	6	4	4	5	3	4	3	3	3
C406.3.1: 10% LPA	9	8	9	9	9	9	10	8	9	9	7	8	8	6	7	7	6
C406.4: Digital Lt Ctrl	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	1
C406.5: Renewable	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
C406.6: DOAS	4	4	4	4	4	3	2	5	3	2	5	3	2	7	4	5	3
C406.7.1: SWH HR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: SWH NG eff	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: SWH HP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: 85% UA	1	4	2	4	4	3	NA	7	4	5	10	7	6	11	10	14	16
C406.9: Low Leak	2	1	1	2	4	1	NA	8	2	3	11	4	1	15	8	11	6

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

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	NA	NA	1	NA	1	1	1	1	2	1	2	2
C406.2.2: 5% Cooling	3	3	2	2	1	1	1	1	1	NA	1	1	NA	1	1	1	NA
C406.2.3: 10% Heating	NA	NA	NA	NA	1	NA	NA	1	1	1	2	2	1	3	2	3	4
C406.2.4: 10% Cooling	5	5	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1
C406.3.1: 10% LPA	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	2
C406.4: Digital Lt Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5: Renewable	8	8	8	8	7	8	8	7	7	7	7	7	7	7	7	7	7
C406.6: DOAS	3	4	3	3	4	2	NA	6	3	4	8	5	5	10	7	11	12
C406.7.1: SWH HR	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.2: SWH NG eff	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.3: SWH HP	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: 85% UA	3	6	3	5	4	4	1	4	3	3	4	5	3	5	4	6	6
C406.9: Low Leak	6	5	3	11	6	4	NA	7	3	3	9	5	1	13	6	8	3

C406.1

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

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	4
C406.2.2: 5% Cooling	4	4	3	3	2	2	2	2	1	1	1	1	NA	1	1	1	NA
C406.2.3: 10% Heating	NA	NA	NA	1	1	1	1	2	3	4	3	4	3	4	3	5	7
C406.2.4: 10% Cooling	7	8	7	6	5	4	3	4	3	1	2	2	1	2	2	2	1
C406.3.1: 10% LPA	8	8	8	9	8	9	9	8	9	9	8	9	8	7	8	7	7
C406.4: Digital Lt Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5: Renewable	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5
C406.6: DOAS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.1: SWH HR*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C406.7.2: SWH NG eff*	NA	1	1	1	1	1	1	2	2	3	2	3	2	3	3	3	5
C406.7.3: SWH HPWH*	NA	NA	NA	NA	NA	NA	NA	1	NA	NA	1	1	NA	1	1	1	1
C406.8: 85% UA	3	7	3	4	2	4	1	1	3	1	2	3	NA	4	3	6	9
C406.9: Low Leak	1	1	1	2	NA	NA	NA	NA	NA	NA	1	NA	NA	4	1	4	3

* for schools with full service kitchens or showers

C406.1

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

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	1	NA	1	1	2	2	2	2	3	2	3	4
C406.2.2: 5% Cooling	5	6	4	4	3	3	1	2	2	1	1	2	NA	1	1	1	NA
C406.2.3: 10% Heating	NA	NA	NA	1	1	1	1	2	2	4	3	4	5	5	3	6	8
C406.2.4: 10% Cooling	9	12	9	8	6	6	3	4	4	1	2	3	NA	2	2	2	1
C406.3.1: 10% LPA	13	13	15	14	16	14	17	15	15	14	12	14	14	16	16	14	12
C406.4: Digital Lt Ctrl	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.5: Renewable	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6
C406.6: DOAS	3	4	3	3	3	3	1	3	2	2	2	3	2	4	3	4	4
C406.7.1: SWH HR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.2: SWH NG eff	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.7.3: SWH HP	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C406.8: 85% UA	4	6	3	4	3	3	1	6	4	4	4	5	4	6	5	8	9
C406.9: Low Leak Env	1	1	1	2	1	1	NA	3	1	1	3	2	1	7	3	6	3

C406.1

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

Climate Zone:	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
C406.2.1: 5% Heating	NA	NA	NA	NA	1	1	1	1	1	2	1	2	1	2	2	3	3
C406.2.2: 5% Cooling	5	5	4	4	3	3	2	2	2	1	1	2	1	1	1	1	1
C406.2.3: 10% Heating	NA	NA	NA	1	1	1	1	2	2	3	3	3	3	4	3	5	5
C406.2.4: 10% Cooling	8	9	8	7	5	5	3	4	4	2	2	3	2	2	2	2	2
C406.3.1: 10% LPA	8	8	9	9	9	9	10	8	9	9	7	8	8	8	8	8	7
C406.4: Digital Lt Ctrl	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	1
C406.5: Renewable	8	8	8	8	8	8	8	8	8	7	7	7	7	7	7	7	7
C406.6: DOAS	3	4	3	3	4	3	2	5	3	3	5	4	3	7	5	7	6
C406.7.1: SWH HR**	10	9	11	10	13	12	15	14	14	15	14	14	16	14	15	15	15
C406.7.2: SWH FF eff**	5	5	6	6	8	7	8	8	8	9	9	9	10	10	9	10	11
C406.7.3: SWH HPWH**	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
C406.8: 85% UA	3	6	3	4	3	4	1	5	4	3	5	5	4	7	6	9	10
C406.9: Low Leak Env	3	2	2	4	4	2	NA	6	2	2	6	4	1	10	5	7	4

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

** 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, 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 with Section C406.5 where the entire building is in compliance with 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) and Variable refrigerant flow systems shall exceed listed in the energy efficiency provisions of ANSI/ASHRAE/IESNA 90.1 by 10 percent in accordance with Sections C406.2.1, C406.2, C406.2.3 or C406.4.~~ 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 for heating equipment where selecting C406.2.1 or C406.2.3 and cooling equipment where selecting C406.2.2 or C406.2.4.

C406.2.2 More efficient HVAC cooling performance. 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.

C406.2.3 High efficiency HVAC heating performance. Equipment shall exceed the minimum heating efficiency requirements by 10 percent.

C406.2.4 High efficiency HVAC cooling performance. 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.

C406.3 Reduced lighting power. Buildings shall comply with Section C406.3.1 or C406.3.2.

C406.3.1 Reduced lighting power 10 percent . The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than 90 percent of the total lighting power allowance calculated in accordance with Section C405.3.2.

C406.3.2 Reduced lighting power more than 15 percent. Where the total connected interior lighting power calculated in accordance with Section C405.3.1 is less than 85 percent of the total lighting power allowance calculated in accordance with Section C405.3.2, additional energy efficiency credits shall be determined based on Equation 4-12, rounded to the nearest whole number.

$$AEEC_{LPA} = AEEC_{10} \times 10 \times (LPA - LPD) / LPA \text{ (Equation 4-12)}$$

Where:

$AEEC_{LPA}$ = C406.3.2 additional energy efficiency credits

LPD = total connected interior lighting power calculated in accordance with Section C405.3.1

LPA = total lighting power allowance calculated in accordance with Section C405.3.2

$AEEC_{10}$ = C406.3.1 credits from Tables C406.1(1) through C406.1(5)

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

C406.5.1 Basic Renewable Credits. The total minimum ratings of on-site renewable energy systems shall be one of the following:

1. Not less than ~~1.71~~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 percent of the annual energy used within the building for building mechanical and service water heating equipment and lighting regulated in Chapter 4.

C406.5.2 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

RR_1 = 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.

C406.7.1 Building type. To qualify for this credit, the building shall contain one of shall be 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.

~~types to use this compliance method:~~

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 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 is 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.

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.

Reason Statement: The C406 Option Packages was introduced into the IECC in 2012 as part of the prescriptive method to achieve an additional 4% energy savings over the prescriptive requirements of the code. The original proposal included three additional options (reduced lighting power density, increased HVAC efficiency and renewables). The 2018 IECC now has eight options to select from. In 2018, PNNL performed an analysis to determine the energy savings potential for each of the eight options and found significant savings differences.

How does the proposed measure compare to what's required in current codes?

The current additional efficiency package options are all considered equal in the 2018 IECC, and any one item must be selected to comply with the extra efficiency provision. However, there is a great deal of variation in the energy savings, as shown in Figure 1.

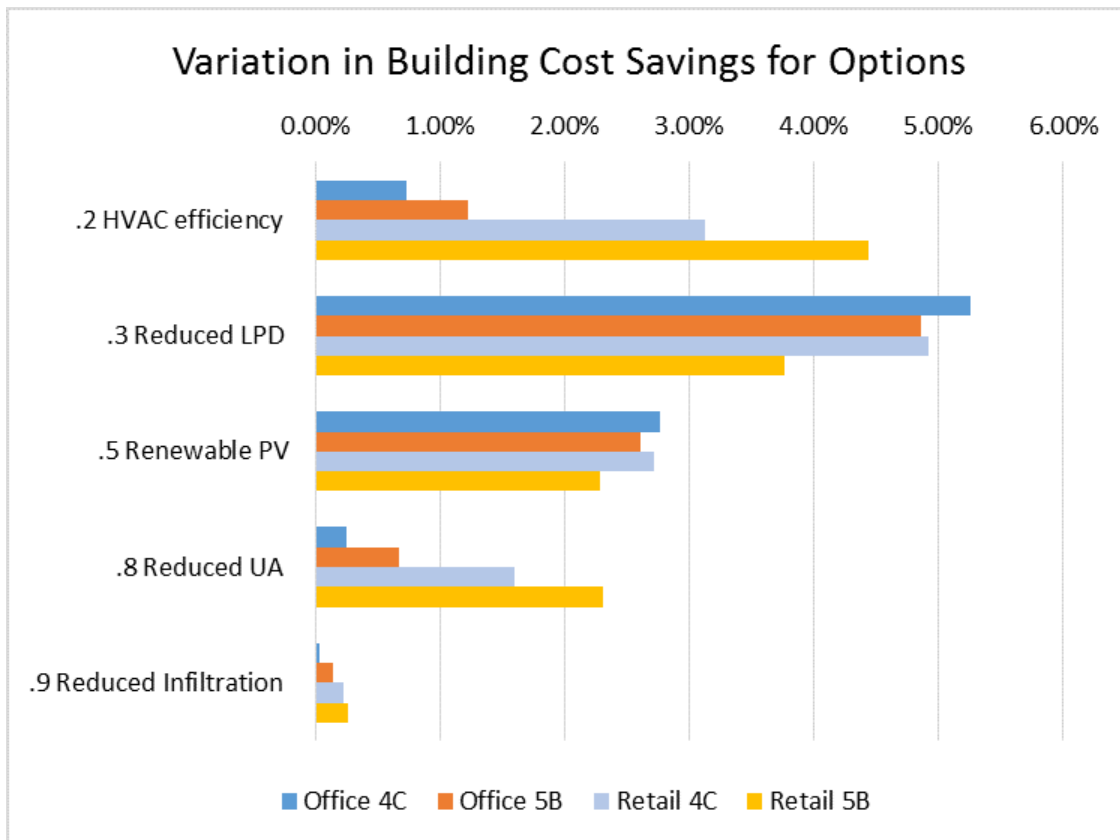


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To address this issue PNNL developed a points based option that provides equity across the efficiency measure options. The analysis is presented in their technical brief “Relative Credits for Extra Efficiency Measures”

C406 - Additional Efficiency Credits

http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370.pdf

Technical Analysis

The technical analysis was conducted as follows:

· Prototype models are used in the analysis. Their development, and associated climate locations, are described in detail in the quantitative determination[1] and are available for download.[2] Four building prototypes were used to capture the difference between building types:

- Medium office
- Primary School
- Mid-rise Apartment
- Stand Alone Retail

EnergyPlus™ was used to evaluate each measure in the four prototypes in all U.S. climate zones, except in cases where there is not a strong interaction with building HVAC systems, where standard engineering calculations were used. This applies to service hot water and renewable energy. Dedicated outdoor air systems (DOAS) savings were estimated rather than modeled, as discussed in the “Relative Credits for Extra Efficiency Measures”.

· Using average annual commercial energy prices, cost savings for each measure are calculated as a percentage of building total annual energy cost.

The cost percentages are converted to credit points, with the goal of not being exactly equivalent, but to provide approximate relative equivalency between measures. One point is assigned for each 0.25% of building energy cost savings.

Extra efficiency measures save energy by reducing energy use directly or reducing the heating or cooling loads in the building, resulting in lower HVAC energy use. The measure would require different items to be added to construction, depending on the combination of credits selected. The requirements for each measure are discussed under the individual items.

Why is an energy efficiency credit assignment method superior to other approaches?

The extra efficiency credit approach allows for designer and builder flexibility. While it is slightly more complicated to select multiple items and add up points, in many cases credit would be given for measures that are often included in buildings. Furthermore, using points rather than “just pick one” puts the options on more of a level consideration and better accounts for the impact of climate.

The climate zone impact is fairly broad, especially for cooling efficiency and building envelope measures. The spread is also broad for lighting reduction and plug load controls, as the reduced heat load must be made up by the heating system in colder climates, while in warmer climates there is added savings in the cooling system. Assigning the points relative to building energy cost savings and climate zone will reward savings measures appropriate to the location of the building, and more fairly across measures.

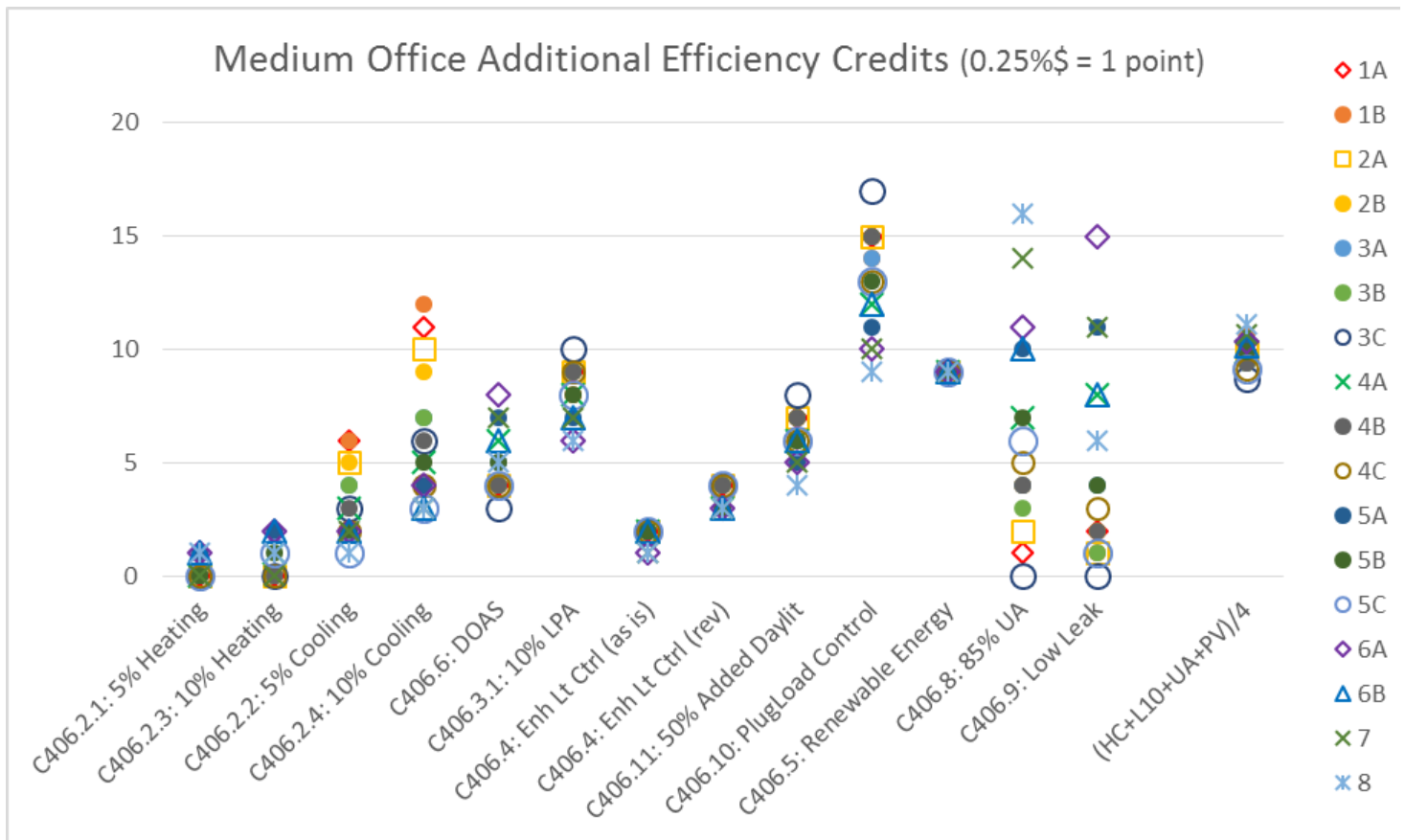


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The points resulting from averaging four typical C406 measures (10% HVAC, 10% LPA, Renewable and 85% UA) are shown as the last item on the right side of Figure 2. These four average around 10 points across climate zones, while lighting power allowance—a popular option selection—averages around 8 points across climate zones. Selecting 10 points or 2.5% savings of building energy cost as the target of a point-based system makes sense as being slightly ahead or roughly equal to the approach followed in the 2018 IECC.

What strategies are considered to minimize compliance burdens?

To achieve savings from a combination of multiple measures under the 2018 IECC, the only recourse is to follow the performance path that requires a building model. Having a simple table of points for measures in different building types and climate zones bypasses the need for full performance modeling, which can be expensive relative to savings for smaller buildings. The end result is a performance-based approach that can be applied with the simplicity of a prescriptive approach.

Are there existing codes and standards that take a similar approach?

The outlined approach is based on the structure currently employed in the IECC for commercial buildings. It just shifts from a “pick one” approach to one that selects adequate measures from the options to meet a required point level. It is also similar to packages of measures that have been utilized in both residential and commercial energy codes, particularly in the Pacific Northwest. The Washington code has successfully used such a structure to balance energy performance, design flexibility, and evolving technologies.

The existing measures were modified to better fit within the points option and to provide more flexibility.

More efficient HVAC heating performance (C406.2) There has been industry feedback that it is difficult to comply with the 10% increase in efficiency for the More Efficient HVAC Option because both the heating and cooling equipment must comply. The points option allows either heating or cooling or both to comply. This measure would be modified to provide separate credits for the following:

- Medium efficiency HVAC heating performance (C406.2.1) is a 5% improvement in efficiency over the existing minimum requirement.
- Medium efficiency HVAC cooling performance (C406.2.2) is a 5% improvement in efficiency over the existing minimum requirement.
- High Efficiency HVAC heating performance (C406.2.3) is a 10% improvement in efficiency over the existing minimum requirement.
- High Efficiency HVAC cooling performance (C406.2.4) is a 10% improvement in efficiency over the existing minimum requirement

Note: If equipment efficiency tables for VRF or other items are added by another proposal, then remove the reference to the ASHRAE 90.1 tables and adjust the table number reference range to include all HVAC equipment tables.

- **C406.3 Reduced lighting power.** The proposal keeps the 10% reduced lighting power allowance threshold and adds a threshold of 15%. Lighting designers that want to design to lower LPD levels can also use the calculation (Equation 4-12) to achieve more points giving them more flexibility.
- **C406.5 On-site renewable energy.** The onsite renewable energy credit has been modified to allow for additional credit from increased system size over the base level requirement for this credit.
- **C406.7.1 Reduced energy use in service water heating.** The water heating option allows for credit for high efficiency gas and electric water heaters in addition to heat recovery.

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Cost Impact

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 assess relative savings equity amongst current options, and 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 several of the evaluated options are 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.

C406 Points Option
