CECD1-18-22

IECC: SECTION 202 (New), C406.1.1.1 (New), C406.1.1.1, C502.3.7.1 (New)

Proponents: Greg Eades, representing IECC CE Modeling, Whole Building Metrics, Zero Energy subcommittee

2024 International Energy Conservation Code [CE Project]

Add new definition as follows:

PURCHASED ENERGY. energy or power purchased for consumption and delivered to the building site.

Add new text as follows:

C406.1.1.1 Buildings without heat pumps. *Buildings* using *purchased energy* that is not electricity for space heating or *service water heating*, *buildings* with electric storage water heaters that are not heat pumps and buildings with total heat pump space heating capacity less than the space heating load at heating design conditions calculated in accordance with Section C403.1.1 shall comply with measures from C406.2 to achieve not less than 1.25 multiplied by 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 multiplied by 1.25 and weighted by the gross conditioned 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. Portions of *buildings* devoted to manufacturing or industrial use.
2. *Buildings* complying with all of the following:

   2.1 The *building's* peak heating load calculated in accordance with Section C403.1.1 is greater than the *building's* peak cooling load calculated in accordance with Section C403.1.1.

   2.2 The *building's* total heat pump space heating capacity is not less than 50% of the *building's* space heating load at heating design conditions calculated in accordance with Section C403.1.1.

   2.3 Any energy source other than electricity or *on-site renewable energy* is used for space heating only when a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.

   2.4 Electric resistance heat is used only in accordance with Section C403.4.1.1.

3. Low-energy *buildings* complying with Section C402.1.1.1.
4. Portions of *buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, or High-Hazard Group H.

Revise as follows:

~~**C406.1.1.1**~~ **C406.1.1.2 Building Core/Shell and Initial Build-Out Construction.** Where separate permits are issued for core and shell buildings and build-outconstruction, 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~~ by Sections C406.1.1 and C406.1.1.1 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~~ by Sections C406.1.1 and C406.1.1.1.

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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 achievedshall 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~~ by Sections C406.1.1 and C406.1.1.1.

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~~ by Sections C406.1.1 and C406.1.1.1.

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

Add new text as follows:

C502.3.7.1 Additions not served by heat pumps. *Additions* using *purchased energy* that is not electricity for space heating or *service water heating*, *additions* served by electric storage water heaters that are not heat pumps and *additions* served by total heat pump space heating capacity less than the peak space heating load at heating design conditions calculated in accordance with Section C403.1.1 shall comply with measures from Sections C406.2 and C406.3 to achieve not less than 67.5 percent of 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 this section. *Alterations* to the existing building that are not part of an *addition*, but permitted with an *addition*, may be used to achieve the required credits.

Exceptions:

1. *Buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, or High-Hazard Group H.
2. *Additions* less than 1,000 ft^2 (92 m^2) and less than 50 percent of existing floor area.
3. *Additions* that do not include the addition or replacement of equipment covered by Tables C403.3.2(1) through C403.3.2(16) or Section C404.2.
4. *Additions* that do not contain conditioned space.
5. Where the *addition* alone or the existing building and *addition* together comply with Section C407.
6. *Additions* complying with all of the following:

   6.1 The *addition's* peak heating load calculated in accordance with Section C403.1.1 is greater than the *addition's* peak cooling load calculated in accordance with Section C403.1.1.

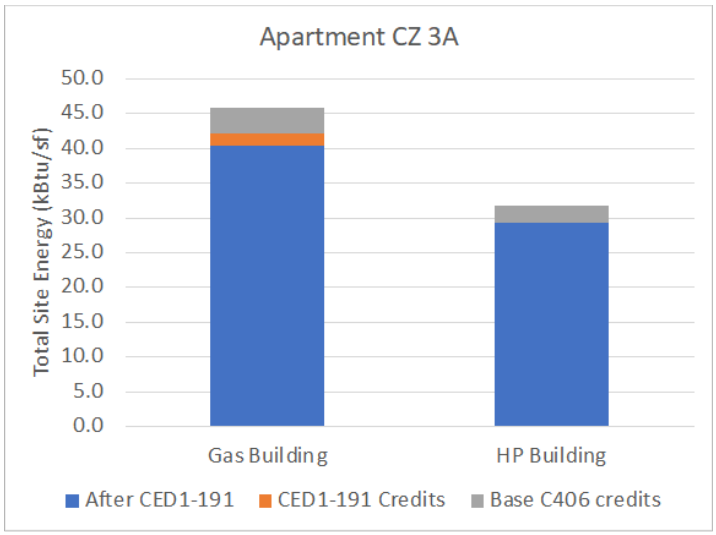
   6.2 The *addition's* total heat pump space heating capacity serving the *addition* is not less than 50% of the *addition's* space heating load at heating design conditions calculated in accordance with Section C403.1.1.

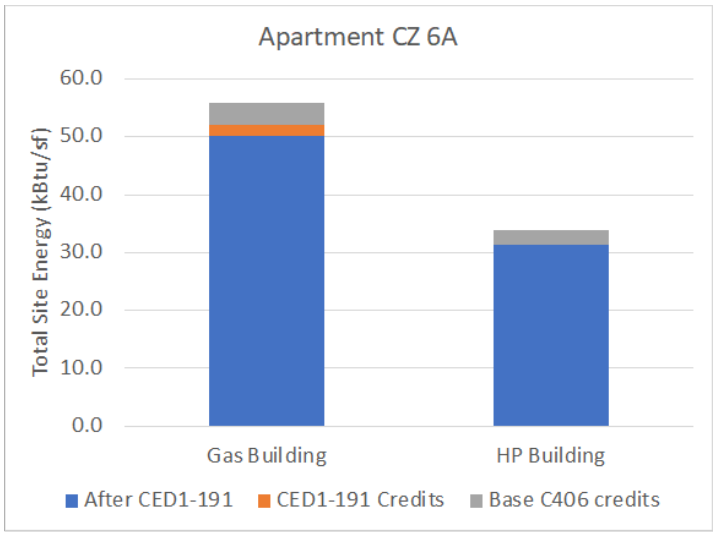
   6.3 Any energy source other than electricity or *on-site renewable energy* is used for space heating serving the *addition* only when a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.

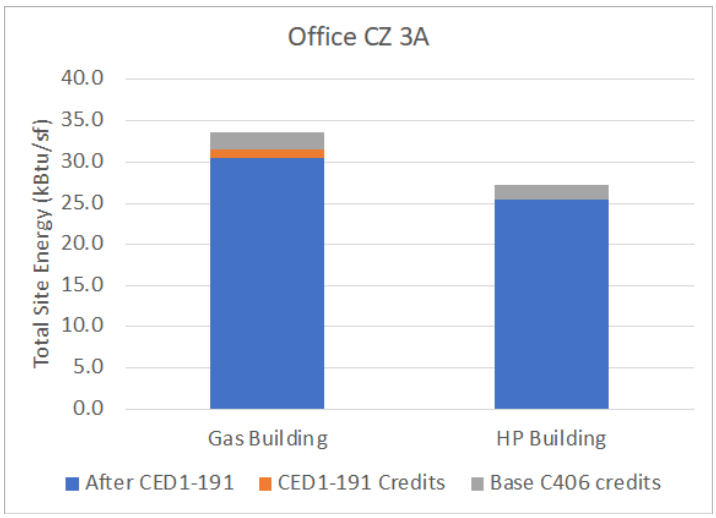
   6.4 Electric resistance heat serving the *addition* is used only in accordance with Section C403.4.1.1.

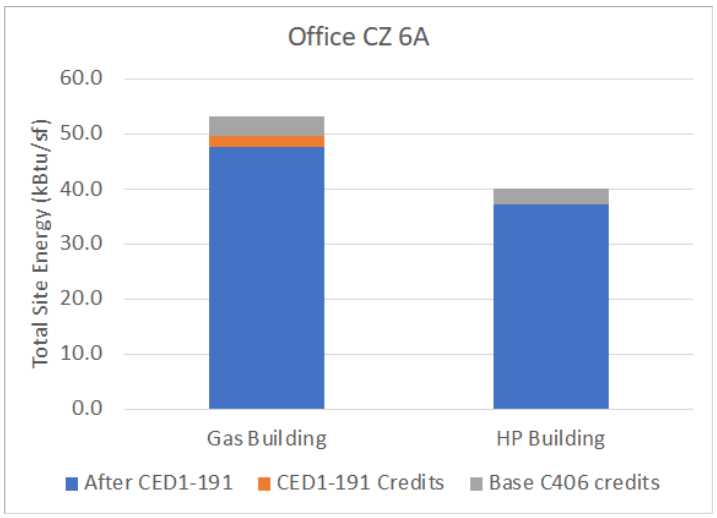
7. Low-energy *buildings* complying with Section C402.1.1.1.

Reason: The additional energy efficiency credit flexibility is of great value, and the increased requirement for energy savings in this proposal are important. However, the public review draft does not recognize the differences among buildings primarily relying on efficient electric technologies and buildings that continue to rely on fossil fuels for their space heating, water heating and cooking end uses in either their site energy usage or in the imperative to decarbonize buildings. Electric alternatives to fossil fuel systems require less site energy usage, generally considerably less with heat pump coefficients of performance for space and water heating (see Figure 1). In general, efficient electric technologies are also already the lowest emission option across end uses. However, in some locations, the use of fossil fuels for peak heating requirements at very low outside air temperatures may represent a comparable site energy option and the lowest emission option when compared to electric resistance supplemental heat in the near- or medium-term. Therefore, it is prudent to allow for flexibility in the model code with an exception for buildings with heat pump heating capacity of more than half of the building's peak heating demand, so long as other heating sources are not the primary heating source. The proposed changes set 50% higher energy efficiency requirements for buildings that use fossil fuels for anything other than peak space heating needs or that primarily rely on electric resistance for space or water heating. This same 50% higher level is included in proposed Section C502.3 text for Additions, which require 50% of those for new buildings.


Apartment CZ 3A
Total Site Energy (kBtu/sf)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Gas Building
HP Building
After CED1-191
CED1-191 Credits
Base C406 credits


Apartment CZ 6A
Total Site Energy (kBtu/sf)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Gas Building
HP Building
After CED1-191
CED1-191 Credits
Base C406 credits


Office CZ 3A
Total Site Energy (kBtu/sf)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Gas Building
HP Building
After CED1-191
CED1-191 Credits
Base C406 credits


Office CZ 6A
Total Site Energy (kBtu/sf)
60.0
50.0
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0.0
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HP Building
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CED1-191 Credits
Base C406 credits

Fig. 1: Comparing site EUI of fossil fuel and electric heat pump buildings using DOE prototype models

Cost Impact: The code change proposal will neither increase nor decrease the cost of construction.
The number of credits that the original proponent of these changes (PNNL) set for Section C406 were determined based on a cost-effectiveness test using an unreasonably high 9.3% nominal discount rate. The Commercial Consensus Committee approved cost-effectiveness criteria of both a 5.3% nominal discount rate and a 9.3% nominal discount rate. The 5.3% discount rate is much more appropriate for this analysis. For PNNL's original submission, they used an 8% nominal discount rate and proposed a set of credit requirements more than 14% higher (area-weighted average by building type and climate zone) than those in the public review draft. A straight line extrapolation would yield 43% higher credit requirements; because the discount rate effect is non-linear, it is reasonable to expect the level of cost-effective credits required to comfortably exceed 50% above those in the public review draft. Although detailed data is not available from PNNL, further analysis using the outputs of PNNL's cost-effectiveness analysis and the DOE prototype models indicates that an additional 25% higher energy efficiency credits would have to cost an average of 12.2 times the upfront cost of the base credits to violate the cost-effectiveness criteria with a 9.3% nominal discount rate (16.6 times the base credits' upfront cost with a 5.3% nominal discount rate, as shown in Fig. 2). A similar analysis was presented to the Commercial Consensus Committee for an additional 50% credit requirement; here it's even stronger at 25% and excluding Storage spaces. The public review draft's Appendix CF includes an "Advanced Energy Credits Package" double that of the Section C406 requirements, which PNNL determined to be the maximum credits a jurisdiction could reasonably require. Taken together, this indicates that 50% higher energy efficiency credits would be rather easily cost justified regardless of the heating and hot water systems.

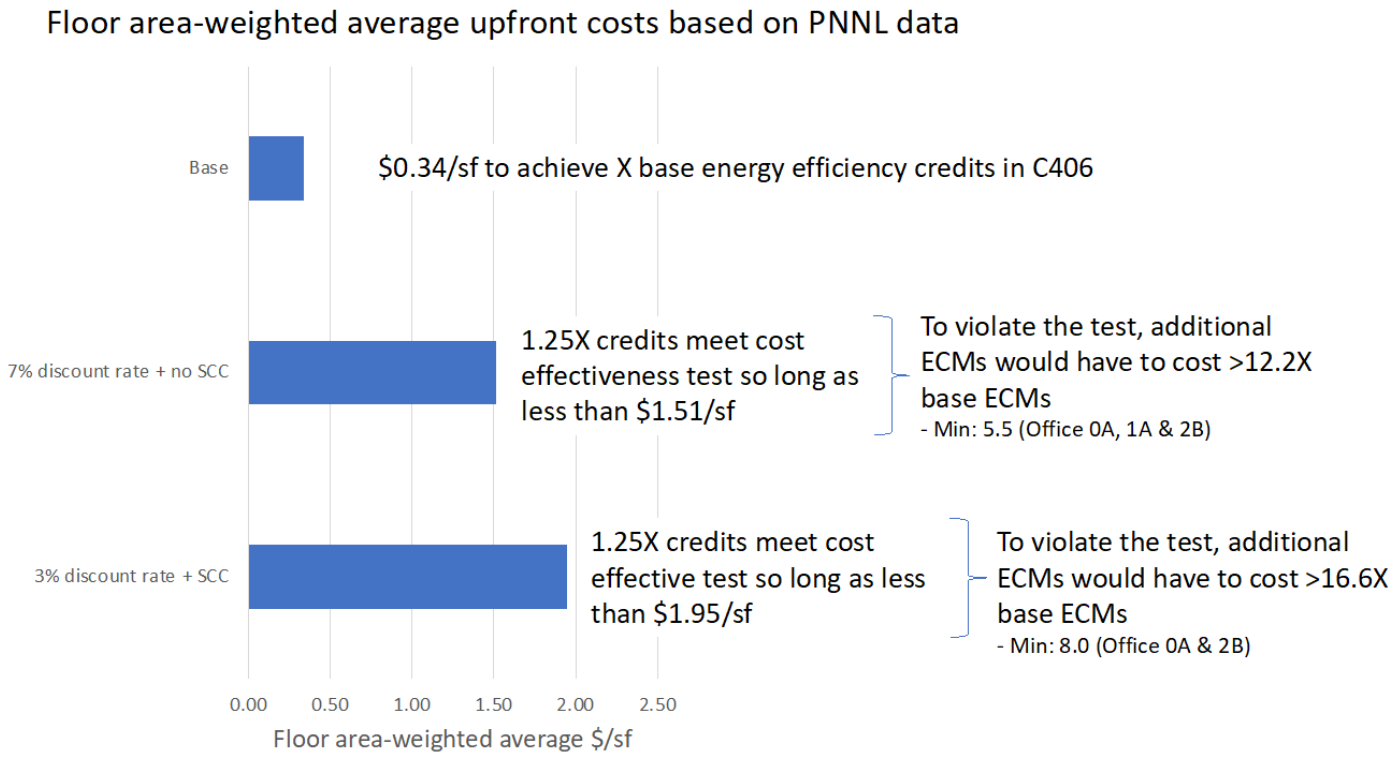

Fig. 2: Cost-effectiveness analysis using PNNL data

In addition to the base cost-effectiveness analysis support, the Commercial Consensus Committee provided the option of including a social cost of carbon in cost-effectiveness calculations. PNNL also did not do calculations showing what that high-efficiency cost-effective credit package level would be with a SCC. Further, there is mounting evidence supporting a SCC more than 3X higher than that recommended by the Committee, which warrants further consideration.

This background is somewhat inconsequential as there were indeed cost-effective credit levels with the high discount rate used by PNNL. Under this proposal, anyone can submit a design that meets those low credit levels for a building with electric heat pumps as the primary space heating and water heating equipment. If they choose to use fossil fuel or electric resistance equipment, they would have to meet a higher number of energy efficiency credits. The entire code has separate energy efficiency requirements depending on the fuel and equipment type chosen, so this proposal is consistent with the current code.

The IECC will often allow less efficiency depending on design decisions without consideration of cost-effectiveness (e.g. where a designer chooses to have a window instead of an opaque wall or in relaxing lighting power density requirements to allow for non-essential services such as advertising lighting). The Committee is certainly not precluded from considering higher efficiency requirements following particular design decisions. The Committee is also not precluded from considering the societal benefits of reducing greenhouse gas emissions, such as they did explicitly in the justification for on-site renewable energy requirements in this public review draft.

In summary: (1) this proposal is cost-effective and (2) the Committee does not have to base its decisions on cost-effectiveness alone.