Appeal of penalty provisions for non heatpump buildings

in the

2024 draft International Energy Conservation Code - Commercial

Building Owners and Managers Association International

and the

National Multifamily Housing Council

December 2023

Specific description of the issue being appealed:

Sections C406.1.1.1 and C502.3.7.1 of the draft 2024 International Energy Conservation Code–Commercial (IECC-C) violate the intent and a foundational principle of the IECC by giving preferential treatment to a particular class of products – heat pumps – at the expense of combustion and electric resistance products that serve the same function.

The 2024 IECC-C requires buildings with greater than 2,000 square feet of conditioned floor to comply with Section C406.1.1. Section C406.1.1 requires buildings to earn a specified minimum number of energy efficiency credits from Table C406.1.1(1) based on building occupancy group and climate zone. For R-2 occupancies required energy efficiency credits range from 65 in Climate Zone (CZ) 0A to 90 in CZs 3C, 4B, 4C, 5B, and 5C.

Unlike energy efficiency credit measures in ASHRAE 90.1-2022, where the *"assigned points for each measure are based on relatively equivalent energy cost savings,"* [1] the credit values assigned for the provision of various energy efficiency measures specified in IECC Section C406.1.1 were determined by what percentage of site energy use reduction the measure is calculated to provide.

The IECC-C also requires buildings with greater than 5,000 square feet of conditioned floor area to comply with Section C406.1.1 and Section C406.1.2. Section C406.1.2 requires buildings to earn renewable and load management credits as specified by Table C406.1.2.

Exception 2 of Section C406.1.1 permits the specified minimum number of efficiency credits from Table C406.1.1(1) to be reduced by surplus renewable and load management credits earned above the minimum required by Section C406.1.2, but the reduction is limited to the amount calculated using the formula provided in Exception 2 or to a tabulated credit value, whichever is less. For R-2 occupancies the tabular limit of allowable credit carryover for energy efficiency credit reductions is 5 credits.

In summary, an R-2 occupancy with 5,000 square feet of conditioned floor area in CZ 3C, 4B, 4C, 5B, or 5C is required to earn not less than 85 energy efficiency credits – the base 90 credit requirement minus not more than 5 credits of surplus renewable energy or load management credits. However, the surplus renewable energy or load management credits used to offset required energy efficiency credits must be the lesser of 5 credits or the credit value calculated in the formula provided in Section C406.1.1(2).

The Section C406.1.1(2) formula reduces the credit available to buildings with any fossil fuel equipment (regardless of what portion of the building's energy demands are serviced by fossil fuel equipment, i. e. just a water heater, or just the space conditioning equipment) by reducing the surplus renewable energy or load management credits value by 30 percent compared to an all-electric or all-renewable building. This reduction is presented as a method to account for the distinction in site energy savings for electric equipment versus combustion equipment instead of the more comprehensive source energy or energy cost metrics.

Buildings in CZs 3 – 8 complying with Section C406.1.1 are also required to comply with Section C406.1.1.1, titled Buildings without heat pumps, which requires buildings that use purchased energy (defined as "*energy or power purchased for consumption and delivered to the building site*") that is not electricity for

[1] https://www.energycodes.gov/sites/default/files/2023-07/901_Energy_Credits_Application_Guide_Final_07162023.pdf (page 13, IECC in parentheses)

space heating or service water heating, buildings with electric (resistance) storage water heaters that are not heat pumps, and buildings with total heat pump space heating capacity less than the space heating load, to earn not less than 25 percent more efficiency credits than buildings whose entire space conditioning and service water heating loads are met with heat pumps. Similarly, Section C502.3.7.1 requires additions not served by heat pumps to meet a higher efficiency credit compliance target, an additional 17.5 percent, than additions using combustion or electric resistance equipment.

Restated, a building provided with electric resistance or gas fired storage water heaters, regardless of their efficiency, must earn 25 percent more efficiency credits than a building using heat pump water heaters (HPWH). So do buildings using combustion equipment for space conditioning; they must earn 25 percent more efficiency credits than a building heated with heat pumps regardless of the efficiency of the combustion equipment. Additions with these types of equipment must earn 17.5 percent more.

The penalties for using legal combustion equipment for service water heating is further exacerbated by the discrepancy in efficiency credits awarded in Table C406.2(1) for combustion equipment versus HPWHs. Efficiency points awarded for HPWHs in an R-2 occupancy range, by climate zone, from 12 to 31 credits more than the credits awarded for highly efficient gas water-heating equipment, (defined as not less than 95 percent Et or 0.93 UEF), values substantially higher than Federal minimum efficiencies. Following the logic underpinning credit awards for all energy saving measures, the additional credits awarded to HPWHs by Table C406.2(1) are justified because of the additional site energy savings provided by HPWHs as a percentage of site energy use.

In other words, even without the 25 percent additional efficiency credits required by Section C406.1.1.1, and the 17.5 percent additional efficiency credits required by Section C502.3.7.1, HPWHs are already recognized for their reduced site energy use impacts and incentivized by higher energy credit awards than combustion equipment serving the same purpose. The 25 percent and 17.5 percent additional credit requirements are purely preferential treatment given to particular types of products – heat pumps - at the expense of legal products meeting or exceeding Federal minimum efficiency standards.

The additional efficiency credits requirements applied to buildings utilizing combustion equipment for space or service water heating violate a foundational principle of the IECC – that the provisions "*do not give preferential treatment to particular types or classes of materials, products or methods of construction*."[2]

This violation of a foundational principle of the IECC also is a violation of the core intent of the IECC to provide *"minimum efficiency requirements for buildings that result in the maximum level of energy efficiency that is safe, technologically feasible, and life cycle cost effective, considering economic feasibility, including potential costs and savings for consumers and building owners, and return on investment."*[3]

De facto, a requirement for 25 percent additional energy efficiency credits for buildings using legal, safe, technologically feasible, and life cycle cost effective combustion equipment exceeds minimum efficiency requirements. So too for additions using combustion or electrical resistance equipment being required to earn 17.5 percent more efficiency credits; minimum energy efficiency requirements are exceeded.

[2] 2021 International Energy Conservation Code, preface, page iv.
[3] https://www.iccsafe.org/wp-content/uploads/IECC-COM-PCD2.pdf (Section C101.3, Intent)

Code change proposal CECD1-18-22[4] introduced the 25 and 17.5 percent combustion equipment penalties. The reason statement for CECD1-18-22 justified the penalties because of the differences in site energy use of combustion equipment and because of the "*imperative to decarbonize buildings*." This rationale, for requirements placed in the main body of the code, is flawed.

As noted previously, the difference in performance in terms of site energy usage – energy efficiency - is already accounted for in the base energy credits awarded to HPWHs versus efficient gas water heaters installed in R-2 occupancies. This is documented in the reason statement for the Department of Energy proposal that brought the expanded energy measure credits into the IECC-C, CEPI-193-21, which says, *"This proposal includes 40 energy efficiency measures and builds on the former energy credit approaches with a base goal of around 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."*[5] <**emphasis added**>

Further, requirements intended to decarbonize buildings do not meet the intent of the IECC-C, to "*include non-mandatory appendices incorporating additional energy efficiency and* ***greenhouse gas reduction*** *resources developed by the Code Council and others."*[6] **<emphasis added>** Provisions specifically incorporated in the IECC to mitigate greenhouse gas emissions, e.g. to decarbonize buildings, are intended to be placed in nonmandatory appendices. No other provision of the intent section of the IECC-C addresses decarbonization or greenhouse gas reduction.

Statement describing precisely why the issue is being appealed:

The penalty for the use of combustion and electric resistance equipment for space conditioning and service water heating is problematic for multiple reasons.

First, code created market constraints on types of equipment that meet basic, core needs of the multifamily housing industry artificially increase the cost of compliance options, negatively impacting the supply of affordable housing. Further, such artificial constraints create obstacles to the adoption of clean fuel combustion technologies which are being rapidly advanced to market.

The combustion and electric resistance equipment penalties also narrow available packages of energy efficiency credits for code compliance by establishing higher performance thresholds for buildings utilizing such equipment.

Section C406, from its introduction (as Section 506 in previous IECC formatting) in code change EC147-09/10,[7] was intended to offer flexibility via "Advanced Efficiency Package Options," as detailed in its reason statement: "*These options round out the savings in the Proposal and also offer important flexibility in getting to higher levels of efficiency. As energy codes move to higher efficiency levels with new types of strategies, building flexibility into prescriptive codes will offer additional pathways to support market adoption and compliance*."

While the current available energy credit measures for R-2 occupancies as detailed in Table C406.2(1) appear to offer many compliance options, a review of the Section C406.2 credit measure requirements reveals that many credit measures are mutually exclusive (see Sections C406.2.1, C406.2.2, and C406.2.3)

[4] https://www.iccsafe.org/wp-content/uploads/CECD1-18-22.pdf
[5] https://www.iccsafe.org/wp-content/uploads/IECC-Commercial-CAR.pdf (pages 302 - 352)
[6] IECC-C Section 101.3, Intent
[7] https://www.iccsafe.org/wp-content/uploads/IECC1.pdf

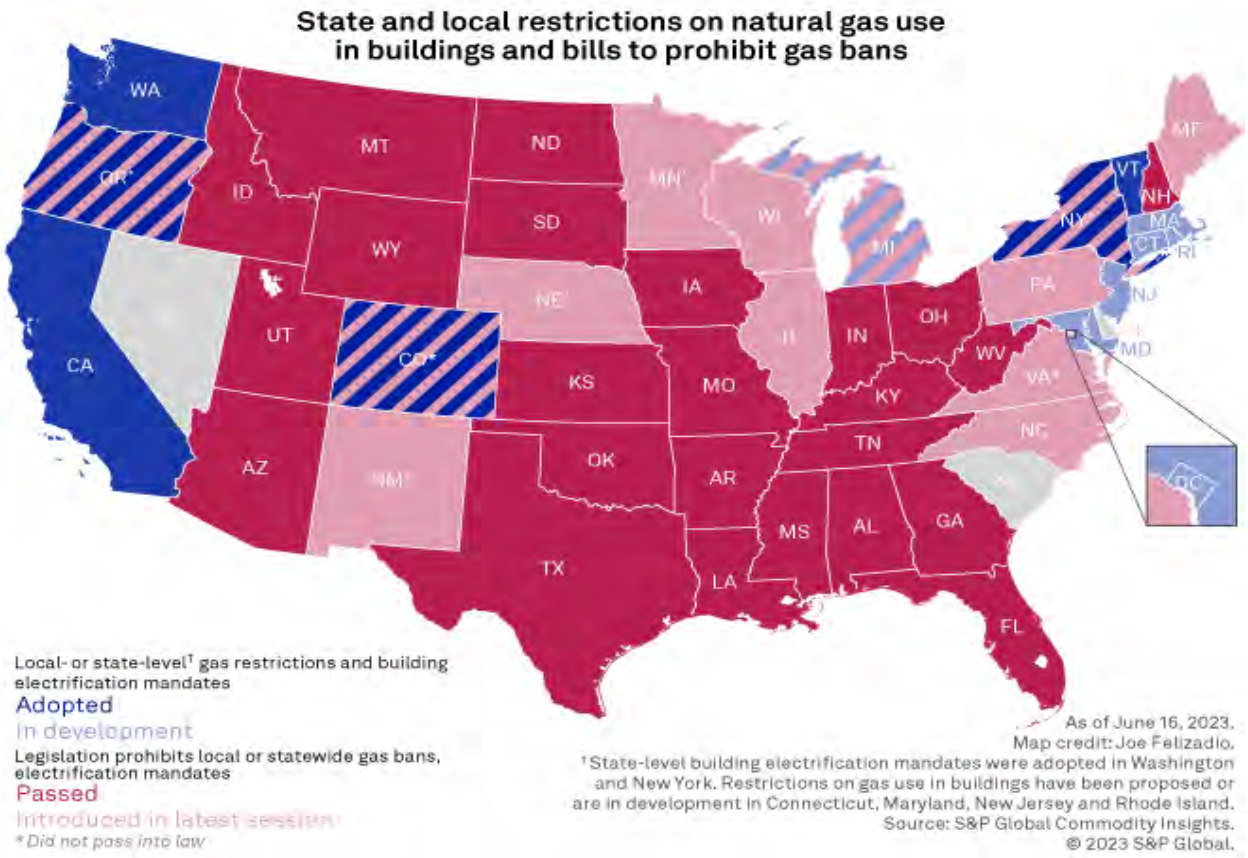
or are applicable at only a building scale versus at an individual dwelling unit scale, (meaning credits awarded only for central systems, which is problematic in R-2 occupancies – as the industry has adopted the use of individual water heating systems to improve water heating costs, metering and useability across all types of multifamily buildings), (see Sections C406.2.3.1.1, C406.2.3.2, C406.2.3.3, C406.2.3.4, C406.2.4, and C406.2.6.4).

Some credit measures are simply impractical, like the Section C406.2.3.4 credit earning requirement for each individual dwelling unit in a Group R-2 occupancy served by a central service water-heating system to 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. The multifamily housing industry, (in part to achieve energy efficiency goals) heavily relies on individual water heating systems, meaning these credits are of limited value.

Given the constraints on available credit options detailed above, the 25 and 17.5 percent equipment penalties are an untenable additional barrier to the flexibility Section C406 has always been intended to offer. Lack of flexibility in design options invariably drives up the cost of compliance; for R-2 occupancies that is equivalent to reducing housing affordability and perhaps availability.

The combustion and electric resistance equipment penalties also may negatively affect adoption of the IECC by state jurisdictions, denying National Multifamily Housing Council (NMHC) and Building Owners and Managers (BOMA) International members the benefit of updated codes in those jurisdictions. The equipment penalties – particularly in the base code - are self-evidently an effort to evade state level statutory prohibitions of local government restrictions on the use of gas equipment. States with such prohibitions are identified in the following map.[8]

[8] https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/half-of-us-states-are-on-pace-to-prohibit-local-gas-bans-76245300



When elected officials discover that model codes are being used to set aside their judgement it raises the question as to whether any part of the code should be adopted or implemented. Local opposition to model energy codes is already a daunting hurdle in many US locations. End-runs of legislated policy are counterproductive to the cause of energy efficiency and energy policy. Codes not adopted save no energy.

Moreover, the penalties on legal combustion and electric resistance equipment (regardless of whether it exceeds Federal minimums or is highly efficient) sets a precedent better avoided. Applying a performance penalty on products because of the nature of the product versus the performance of the product will always violate the foundational principles of the IECC.

Applying the penalties because of the CECD1-18-22 stated reason, "*imperative to decarbonize,*" sets a precedent that aluminum clad windows could be required (penalized) to be more efficient than other types of windows because of the high embodied carbon intensity of aluminum versus other materials. Similarly, assemblies using foam plastic insulation could be required (penalized) to provide higher efficiency performance than assemblies relying on lower embodied carbon insulating materials. These potential scenarios do not consider that aluminum/nonaluminum or foam plastic/nonfoam plastic assemblies are already required to meet the same energy efficiency targets. Penalties would not be applied for noncompliance; penalties would be applied for the method of compliance.

Finally, incorporation of requirements in the IECC that violate the codified intent and foundational principles of the IECC reflect a material and significant irregularity of process.

Detailed description of how the issue being appealed will adversely affect the appellants:

NMHC provides a voice for America's apartment industry. Our membership is engaged in all aspects of the apartment industry, including ownership, development, management, and finance. NMHC represents the principal officers of the apartment industry's largest and most prominent firms.

BOMA International is the leading trade association for commercial real estate professionals for more than 100 years. It represents the owners, managers, service providers and other property professionals of all commercial building types, including office, industrial, medical, corporate, and mixed-use. BOMA International is the voice of commercial building owners and operators.

According to recent research commissioned by NMHC, the U.S. needs to build 4.3 million new apartment homes by 2035 to meet the demand for rental housing.[9] This includes an existing shortage of 600,000 apartments stemming from underbuilding due in large part to the 2008 financial crisis. Further, underproduction of housing has translated to higher housing costs – resulting in a consequential loss of affordable housing units (those with rents less than $1,000 per month), with a decline of 4.7 million affordable apartments from 2015-2020.

In fact, the total share of cost-burdened apartment households (those paying more than 30% of their income on housing) has increased steadily over several decades and reached 57.6% in 2021.[10] During this same period, the total share of *severely* cost-burdened apartment households (those paying more than half their income on housing) increased from 20.9 to 31.0%.[11]

Further, the Biden Administration has recognized this immense need to bolster the nation's housing production and outlined a strategy to improve housing supply conditions through the *Housing Supply Action Plan*. The plan underscores that this national supply shortfall "*burdens family budgets, drives up inflation, limits economic growth, maintains residential segregation, and exacerbates climate change*."[12] And that *"[r]ising housing costs have burdened families of all incomes, with a particular impact on low- and moderate-income families, and people and communities of color."*[13]

It is becoming increasingly difficult to build housing that is affordable to a wide range of income levels. Ongoing materials and equipment shortages and strained supply chain conditions pressures housing development and results in costs and delays that impact overall affordability and availability. In addition, ill-timed, unnecessary, or unduly burdensome laws, policies, and regulations – such as penalties applied to buildings utilizing combustion and electric resistance space conditioning and service water heating equipment - prevent us from delivering the housing our country so desperately needs. Elevated regulatory costs, particularly, create a barrier to affordable housing supply. Recent research published by NMHC and

[9] Hoyt Advisory Services, "Estimating the Total U.S. Demand for Rental Housing by 2035." (2022), https://www.weareapartments.org/
[10] American Housing Survey, U.S. Census Bureau, "NMHC tabulations of 1985 American Housing Survey microdata." (2021).
[11] *Id.*
[12] "President Biden Announces New Actions to Ease the Burden of Housing Costs." (May 16, 2022) https://www.whitehouse.gov/briefing-room/statements-releases/2022/05/16/president-biden-announces-new-actions-to-ease-the-burden-of-housing-costs/
[13] *Id.*

the National Association of Home Builders found that regulation imposed by all levels of government accounts for 40.6 percent of multifamily development costs.[14]

Following extreme, pandemic-fueled volatility in product costs, supply chain stability, and staffing constraints, the apartment construction and renovation pipeline has seen some moderation yet continues to face difficult conditions. Construction delays are prevalent – with 88 percent of respondents reporting delays in NMHC's September 2023 Quarterly Survey of Apartment Construction and Development Activity. Further, 48 percent of respondents reported experiencing repricing increases in projects over the last three months. Respondents experiencing delayed starts cited a range of causes including lack of construction financing and project infeasibility, while the availability of necessary products and materials, or lack thereof, saw the largest increase in responses, with 30 percent of respondents citing materials sourcing and delivery challenges as a contributing factor to delayed starts (up from 10 percent in the last quarter).

Apartment builders and developers also continue to be impacted by escalations in materials costs. The prices of a myriad of essential building products and equipment continue to rise, with respondents reporting a 7% average increase in residential appliance costs over a three-month period. A sizeable portion of respondents further reported relying on alternative brands or suppliers to mitigate price increases and supply shortages for appliances (58%).

Using the IECC to penalize legal, safe, technologically feasible, and lifecycle cost-effective equipment artificially skews markets and further constrains supply chains, fundamentally reducing the ability of NMHC members to meet the nation's housing needs and BOMA International members to meet the changing, post-pandemic needs of commercial building inventories.

Statement indicating the requested remedial action:

NMHC and BOMA International request that Sections C406.1.1.1 and C502.3.7.1 be deleted from the IECC-C for failure to comply with the intent and foundational principles of the IECC-C. Additionally, Section C406.1.1 should be modified by deleting the reference to Section C406.1.1.1.

Alternatively, if the 25 percent penalty in Section C406.1.1.1, and 17.5 percent penalty in Section C502.3.7.1, for the use of combustion and electric resistance equipment are found by the appeals board to comply with the intent of the IECC-C to potentially *"include nonmandatory appendices incorporating additional energy efficiency and greenhouse gas reduction resources developed by the Code Council and others,"* NMHC and BOMA International request that such provisions be placed in a nonmandatory language appendix of the code. In accordance with the direction provided by ICC's February 15, 2022 memorandum,[15] nonmandatory appendices are informational and not adoptable, meaning such appendices are drafted in nonmandatory language.

[14] National Multifamily Housing Council and National Association of Home Builders, "Regulation: 40.6 Percent of the Cost of Multifamily Development." (2022) https://www.nmhc.org/globalassets/research--insight/research-reports/cost-of-regulations/2022-nahb-nmhc-cost-of-regulations-report.pdf

[15] https://www.iccsafe.org/wp-content/uploads/IECC-Discount-Rates-and-Code-Content-Memorandum_02_15.22.pdf

The names and mailing addresses of individuals and organizations that may have an interest in or be affected by the matter being appealed:

Michael Jouaneh Lutron 7200 Suter Road Coopersburg, PA 18036-1299 mjouaneh@lutron.com	Andrew Klein Building Owners & Managers Association Intl. 1101 15th Street NW, Suite 800 Washington, DC 20005 andrew@asklein.com	Emily Lorenz 3721 N Francisco Ave Ste 1 Chicago, IL 60618-3501 emilyblorenz@gmail.com
Mike Waite ACEEE 529 14th Street NW, Ste. 600 Washington, DC 20045 mwaite@aceee.org	Laura G. Petrillo-Groh AHRI 2311 Wilson Blvd Ste 400 Arlington, VA 22201-5420	Hope Medina Shums Code Associates 4610 S Ulster St, Ste 150 Denver, CO 80237 hope.medina@shumscoda.com
Greg Eades USEPA 1425 Chester Rd Raleigh, NC 27608-2021 eades.greg@epa.gov	Jeremy Williams Building Technologies Office US Dept of Energy Forrestal Building 1000 Independence Avenue, SW Washington, DC 20585 jeremy.williams@ee.doe.gov	Don Mock Howard County Department of Inspections, Licenses, and Permits 3430 Court House Drive Ellicott City, MD 21043 dmock@howardcountymd.gov
Steve Rosenstock Edison Electric Institute 701 Pennsylvania Avenue, N.W. Washington, D.C. 20004-2696 srosenstock@eei.org	Shannon Corcoran American Gas Association 400 North Capitol Street, NW, Suite 450 Washington, DC 20001 SCorcoran@aga.org	Robert Ross Austin ISD 1151 County Road 330 Granger, TX 76530-5236 robertross1952@gmail.com
Sean Denniston New Buildings Institute 151 SW 1st Ave Suite 300 Portland, OR 97204 sean@newbuildings.org	John Bade CA Investor Owned Utilities 2050 Partners 81 Coral Drive Orinda CA 94563 johnbade@2050partners.com	Bryan Holland NEMA 1300 17th St N #900, Arlington, VA 22209, USA bryan.holland@nema.org
Michael Tillou PNNL 902 Battelle Blvd, Richland, WA 99354 michael.tillou@pnnl.gov	Vladimir Kochkin NAHB 1201 15th Street NW Washington, DC 20005 vkochkin@nahb.org	Drake Erbe ASHRAE 180 Technology Parkway NW, Peachtree Corners, Georgia 30092 DrakeErbe@airxchange.com
David Goldstein Natural Resources Defense Council 40 West 20th Street 11th Floor New York, NY 10011 dgoldstein@nrdc.org	Daniel Nall American Institute of Architects 1735 New York Ave NW Washington, DC 20006-5292 dannall@mindspring.com	Susan Musngi Camden Property Trust 11 Greenway Plaza, Suite 2400 Houston, TX 77046 RMusngi@camdenliving.com

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July 2023

R Hart
D Maddox
M Tillou
M Rosenberg

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R Hart
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M Rosenberg

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Pacific Northwest National Laboratory
Richland, Washington 99354

Executive Summary

The Standing Standards Project Committee for ASHRAE Standard 90.1 adopted energy credits into ASHRAE Standard 90.1-2022. Energy credits provide additional required prescriptive savings that are more flexible than base prescriptive requirements. The new credit requirement can be met by selecting from 34 available measures that include energy efficiency, renewable energy, and load management options. Building developers select from the available measures to meet a savings target above the base prescriptive requirements. Building-type-specific targets were developed with a goal of achieving an average of 5% total building energy cost savings.

Energy credits have been adopted in other model building energy codes. For example, energy credits were incorporated into the 2018 International Energy Conservation Code (IECC) as a set of eight options, from which one must be selected for compliance. In the 2021 IECC, the energy credit options were expanded to 15 energy saving measures that provides the user with the flexibility to select measures in a combination that achieves at least 2.5% level of energy savings.

The maximum available ASHRAE Standard 90.1 credits from different measure types for each building use type are compared with the 50-point cap on credit requirements in Figure E.1.

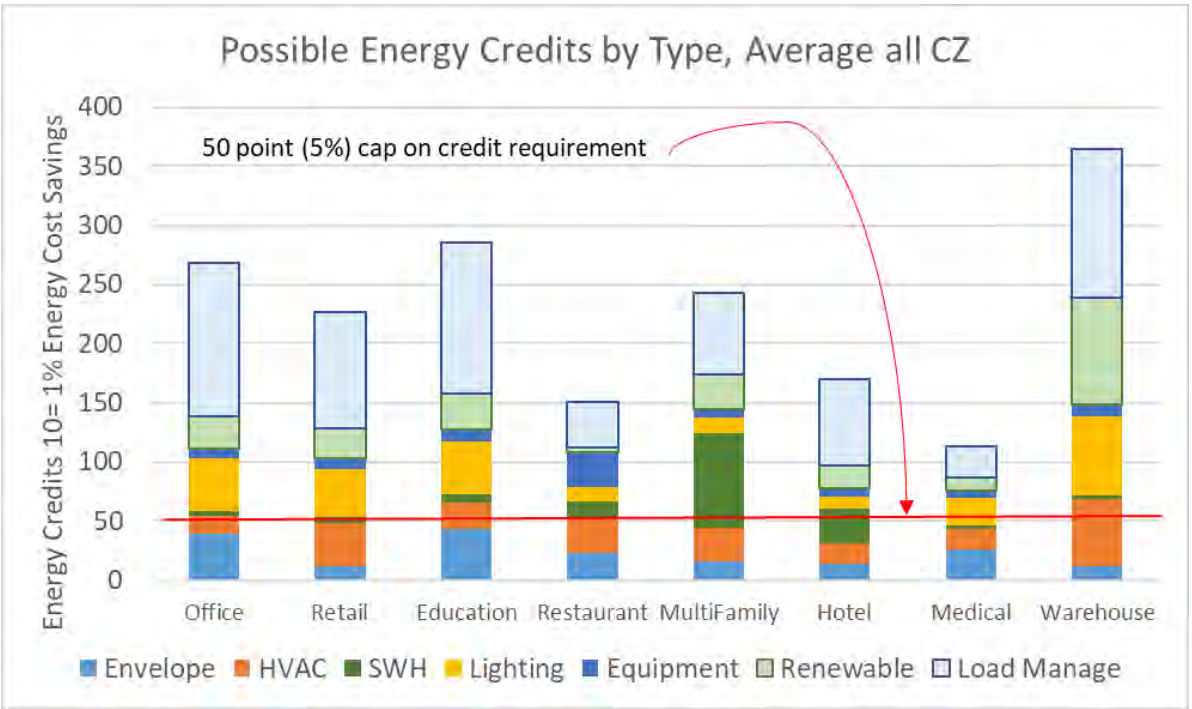

Figure E.1. Available Energy Credits by Building and Measure Type vs. Required Credits

This application guide includes general information about the energy credit requirements in Standard 90.1-2022. Example packages are shown for hot, moderate, and cold climates demonstrating nine alternative ways to meet the energy credit requirements for each building use type. There is also a general description of the energy credit measures, including how they save energy or reduce electric grid costs, and their applicability. The actual code language, credit requirements, and available credits by measure can be found in Standard 90.1-2022.

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1.0 Introduction

The purpose of this document is to assist building designers in complying with the newly adopted energy credit requirements of ASHRAE/ANSI/IES Standard 90.1-2022, *Energy Standard for Sites and Buildings except Low-Rise Residential Buildings* (ASHRAE 2022a), hereafter referred to as Standard 90.1. These new requirements are included in Section 11[1] of Standard 90.1. This document includes the following sections:

- Section 2: "Energy Credit Requirement Development" includes a summary of the rationale behind energy credits, adoption principles, history, and considerations.
- Section 3: "Energy Credit Measures" summarizes the measure types, applicability, and available credits vs. requirements.
- Section 4: "General Energy Credit Provisions and Adjustments" covers which projects are excluded from energy credit requirements and how core and shell projects or mixed occupancy projects are handled. Building use types are also discussed.
- Section 5: "Example Energy Credit Measure Packages" outlines the example packages included in the document with background on the cost-effective, minimum efficiency, and prototype packages. It also reviews, by building type, the energy credit points available for measures with example packages for hot, moderate, and cold climates. This section provides a good starting point for selecting energy credit measures for a user's building and climate.
- Section 6: "Measures to Achieve Credits" provides more background on the individual measures, including applicability, limitations, and energy saving concepts.

[1] The former Section 11, "Energy Cost Budget Method," has been moved to Section 12 so that the Energy Credit requirements will be in sequence with other prescriptive requirements.

2.0 Energy Credit Requirement Development

Energy codes have traditionally contained *mandatory* and *prescriptive* requirements. Mandatory requirements must be complied with in all situations while prescriptive requirements can be traded with other efficiency measures by following either a whole-building or discipline-specific performance path. Recent editions of the International Energy Conservation Code (IECC) also include extra efficiency measures, and adequate measures must be selected to satisfy an "additional" efficiency requirement. The efficiency requirement is stated on a point scale, with each measure assigned points relative to the building efficiency improvement. Such a structure is currently employed in Section C406 of the 2021 IECC (ICC 2021) and similar approaches are in several state building codes.

For Standard 90.1-2022, energy credits were adopted through addendum **ap** and are included in the renumbered Section 11 (ASHRAE 2022b). The energy credit approach has the advantage of providing increasing levels of performance, while maintaining flexibility by allowing designers to select the most appropriate technologies and efficiency measures based on the attributes of each particular project.

2.1 Overall Summary

Here we discuss the history and benefits of energy credits, outline the development, and review cost-effectiveness considerations.

2.1.1 History of Energy Credits

Originally, Section C406 appeared in the 2012 IECC as a "select one of three" options approach for additional efficiency. This approach has evolved over the years to include six options in the 2015 IECC and eight options in the 2018 IECC. In the 2021 IECC, energy credit measures were expanded to 15 measures that provides the user with the flexibility to select measures in a combination that achieves at least 10 credit points, which is equivalent to approximately 2.5% energy savings. See Section 1.0 in *90.1 Energy Credits Analysis Documentation* (Hart et al. 2022) for a more complete history.

The credits adopted into ASHRAE Standard 90.1-2022 through addendum **ap** include 34 energy efficiency, renewable energy, and load management measures. Building-type-specific targets were developed with a goal of 5% total building energy cost savings.

2.1.2 Benefits of Energy Credits

The energy credits include 26 energy efficiency measures, 1 renewable measure, and 7 load management measures. The 90.1 credits build on the former energy credit approaches with a base goal of around 5% energy cost savings. The energy efficiency credits in the proposal are based on site energy cost and each credit point represents 1/10 of 1% (i.e., 0.1%) of total building energy cost savings. Load management measures base their cost savings on grid cost impact represented by a time-of-use electric price structure that has been adopted by The Standing Standards Project Committee (SSPC) 90.1 for evaluation of similar measures. The code approach is to add a prescriptive requirement for additional saving measures that can be selected by design teams to meet the requirements for each building use type and climate zone.

Energy codes include mandatory requirements that all buildings must fulfill, prescriptive requirements that can be used without following a performance path, and discipline[1] 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 is provided the flexibility to 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 efficiency energy credits. These issues are addressed in the code language through modifications to the Energy Cost Budget in 90.1 Section 12 and a process for modifying building performance factors for Appendix G.

2.1.3 Energy Credit Development

Energy credits have been developed from typical efficiency measures used in green building programs, new construction utility incentive programs, and Advanced Energy Design Guidelines (ASHRAE 2019). More detail is included in Section 1.4 of *90.1 Energy Credits Analysis Documentation* (Hart et al. 2022).

2.1.4 Cost-Effectiveness Considerations

While baseline prescriptive requirements usually undergo individual review for cost-effectiveness, the approach for energy credit measures is different. In general, any measure can be selected for a particular building; however, not all measures are required. Thus, the approach to establish cost effectiveness is to demonstrate that at least one package of measures is cost effective using the ASHRAE Standard 90.1 scalar method. More detail is included in Section 2.2 of *90.1 Energy Credits Analysis Documentation* (Hart et al. 2022).

2.2 Energy Credit Adoption Principles

Energy credits have been used in numerous energy codes, especially the IECC, for more than a decade. A working group on energy credits reporting to ASHRAE's 90.1 SSPC was established in November 2019. Initially, the working group was ad hoc, exploring the energy credit concept, and in April 2020, after presenting initial findings, a chartered working group was established, since this cross-discipline proposal was not appropriate for a single existing subcommittee. As the working group met, the group members moved toward agreement around several options in energy credit development. While the principles here reflect at least a majority opinion of the working group, it is acknowledged that there are some contrary minority opinions. As with all addenda to 90.1, addendum **ap** went through public review. Based on helpful feedback from the process and members of the SSPC as a whole, the proposal was modified to reflect these principles (ASHRAE 2022b). The agreed-to principles for selecting measures and determining credits are listed here and discussed in detail in *90.1 Energy Credits Analysis Documentation* (Hart et al. 2022):

- Calculate energy cost savings relative to prescriptive requirements and general practice.
- Establish energy credits for different building types and climate zones based on prototype analysis and end-use proration; allow for non-simulated building types as well as additions and alterations.

[1] An example of a discipline performance path is the Building Envelope Trade-Off Compliance Path in the envelope discipline of Standard 90.1 that is supported by Appendix C. There are current proposals under public review in Standard 90.1 for discipline performance paths for both lighting and HVAC disciplines.

- Determine credits for measures that are based on approximate energy cost savings equivalency
- Use measure descriptions that are based on prescriptive descriptions and do not require performance analysis.
- Where possible, integrate energy credits with discipline trade-off or performance paths such as the envelope tradeoff, heating, ventilation, and air conditioning (HVAC) performance, or lighting performance methods.
- Establish energy credit requirements by building type and climate zone based on cost-effective demonstration packages of reasonably applicable measures.
- Limit the share of credits from renewables and load management to ensure a balanced portion of credits from energy efficiency.
- Ensure that required energy credits are accounted for in the performance paths by adjusting the Energy Cost Budget formula and including energy credits in the Appendix G Building Performance Factors.
- Review future measures for addition to the measure energy credits based on these criteria.

2.3 General Energy Credit Considerations

How do energy credits compare to what's required in past codes?

Before 2022, Standard 90.1 did not employ energy credit measures. In the 2021 IECC, points for the additional energy efficiency measures are assigned by building type and climate zone rather than all having the same requirements, as is done in the 2018 IECC (ICC 2018). The 2021 IECC required that sufficient measures must be included in the building design until at least 10 points are achieved. That increased building savings by about 2.5% of total building energy cost compared with the base prescriptive path requirements.

Standard 90.1-2022 adds energy credit measures to 90.1 in a similar manner to the 2021 IECC and distinguishes requirements based on building type and climate zone. The energy credit points attributed to individual measures are determined mostly from building simulation prototype analysis. The assigned points for each measure are based on relatively equivalent energy cost savings (credits in the IECC are based on site energy savings). Each efficiency measure credit equals 0.1% of total building energy cost based either on average national energy prices or a composite time of use electric price schedule. For example, a score of 10 credits represents a 1% energy cost reduction for the building as a whole and a score of 50 credits represents a 5% reduction.

What are the benefits of using the energy efficiency credit assignment method?

The extra efficiency credit approach provides compliance flexibility to designers and builders. Project teams select measures that make the most sense for their specific building design, typically considering cost-effectiveness and constructability issues. The approach does require selecting multiple items and adding up points; however, in many cases, credit can be earned for measures that are often included in buildings but not previously accounted for in prescriptive compliance. Expanding the number of measures available for achieving credits makes it possible for buildings to save more, allowing the credit requirements to be set initially with a target of 5% total building cost savings.

What strategies are considered to minimize compliance burdens?

To achieve deeper savings in response to energy and carbon reduction policy goals, energy credits provide a more expedient compliance path than the performance path, which requires developing a custom building model using simulation software. By expanding the number and flexibility of options for achieving energy credits and differentiating credits by building type, additional savings can be achieved with a simplified approach. To streamline its implementation and review, the energy credit measures included in DOE's COMcheck compliance software[1] for the 2021 IECC can be expanded to include the 90.1 measures introduced in Addendum **ap**. While some additional review is required for the building official, it is less complex than the review typically required for a whole building model.

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

The outlined approach is an expansion of the structure currently employed in the 2021 IECC for commercial buildings, which has been adopted by several states. The credits approach has been used in the Washington State Energy Code since the 2015 edition, with good results (WSBCC 2015). The Washington State and Seattle energy codes have successfully used the approach to address and balance multiple project considerations, including energy performance, design flexibility, and evolving technologies.

How do load management and renewable measures fit in?

Load management and renewable measures are included in the energy credits even though they do not always save energy, and in some circumstances may increase energy use. These measures are included because they make more flexible and effective use of energy on the grid. Buildings can absorb excess energy when grid-level renewable generation is high or shave peak power when net grid demand is high. This reduces the need for peaking fossil fuel electrical generation and makes better use of renewable energy. Proper grid management helps improve grid resilience and reduce source energy and carbon emissions.

[1] https://www.energycodes.gov/comcheck

PREFACE

Introduction

The *International Energy Conservation Code*® (IECC®) establishes minimum requirements for energy-efficient buildings using prescriptive and performance-related provisions. It is founded on broad-based principles that make possible the use of new materials and new energy-efficient designs. This 2021 edition is fully compatible with all of the International Codes® (I-Codes®) published by the International Code Council® (ICC®), including the *International Building Code*® (IBC®), *International Existing Building Code*® (IEBC®), *International Fire Code*® (IFC®), *International Fuel Gas Code*® (IFGC®), *International Green Construction Code*® (IgCC®), *International Mechanical Code*® (IMC®), *International Plumbing Code*® (IPC®), *International Private Sewage Disposal Code*® (IPSDC®), *International Property Maintenance Code*® (IPMC®), *International Residential Code*® (IRC®), *International Swimming Pool and Spa Code*® (ISPSC®), *International Wildland-Urban Interface Code*® (IWUIC®), *International Zoning Code*® (IZC®) and *International Code Council Performance Code*® (ICCPC®).

This code contains separate provisions for commercial buildings and for low-rise residential buildings (3 stories or less in height above grade). Each set of provisions, IECC—Commercial Provisions and IECC—Residential Provisions, is separately applied to buildings within its respective scope. Each set of provisions is to be treated separately. Each contains a Scope and Administration chapter, a Definitions chapter, a General Requirements chapter, a chapter containing energy efficiency requirements and an Existing Buildings chapter containing provisions applicable to buildings within its scope.

The I-Codes, including the IECC, are used in a variety of ways in both the public and private sectors. Most industry professionals are familiar with the I-Codes as the basis of laws and regulations in communities across the US and in other countries. However, the impact of the codes extends well beyond the regulatory arena, as they are used in a variety of nonregulatory settings, including:

- Voluntary compliance programs such as those promoting sustainability, energy efficiency and disaster resistance.
- The insurance industry, to estimate and manage risk, and as a tool in underwriting and rate decisions.
- Certification and credentialing of individuals involved in the fields of building design, construction and safety.
- Certification of building and construction-related products.
- US federal agencies, to guide construction in an array of government-owned properties.
- Facilities management.
- "Best practices" benchmarks for designers and builders, including those who are engaged in projects in jurisdictions that do not have a formal regulatory system or a governmental enforcement mechanism.
- College, university and professional school textbooks and curricula.
- Reference works related to building design and construction.

In addition to the codes themselves, the code development process brings together building professionals on a regular basis. It provides an international forum for discussion and deliberation about building design, construction methods, safety, performance requirements, technological advances and innovative products.

Development

This 2021 edition presents the code as originally issued, with changes reflected in the 2000 through 2018 editions and further changes approved through the ICC Code Development Process through 2019. A new edition such as this is promulgated every 3 years.

This code is founded on principles intended to establish provisions consistent with the scope of an energy conservation code that adequately conserves energy; provisions that do not unnecessarily increase construction costs; provisions that do not restrict the use of new materials, products or methods of construction; and provisions that do not give preferential treatment to particular types or classes of materials, products or methods of construction.

Maintenance

The IECC is kept up to date through the review of proposed changes submitted by code enforcement officials, industry representatives, design professionals and other interested parties. Proposed changes are carefully considered through an open code development process in which all interested and affected parties may participate.

The ICC Code Development Process reflects principles of openness, transparency, balance, due process and consensus, the principles embodied in OMB Circular A-119, which governs the federal government's use of private-sector standards. The ICC process is open to anyone; there is no cost to participate, and people can participate without travel cost through the ICC's cloud-based app, cdpACCESS®. A broad cross-section of interests are represented in the ICC Code Development Process. The codes, which are updated regularly, include safeguards that allow for emergency action when required for health and safety reasons.

In order to ensure that organizations with a direct and material interest in the codes have avoice in the process, the ICC has developed partnerships with key industry segments that support the ICC's important public safety mission. Some code development committee members were nominated by the following industry partners and approved by the ICC Board:

• National Association of Home Builders (NAHB)
• National Multifamily Housing Council (NMHC)

The code development committees evaluate and make recommendations regarding proposed changes to the codes. Their recommendations are then subject to public comment and council wide votes. The ICC's governmental members—public safety officials who have no financial or business interest in the outcome—cast the final votes on proposed changes.

The contents of this work are subject to change through the code development cycles and by any governmental entity that enacts the code into law. For more information regarding the code development process, contact the Codes and Standards Development Department of the ICC.

While the I-Code development procedure is thorough and comprehensive, the ICC, its members and those participating in the development of the codes disclaim any liability resulting from the publication or use of the I-Codes, or from compliance or noncompliance with their provisions. The ICC does not have the power or authority to police or enforce compliance with the contents of this code.

Code Development Committee Responsibilities (Letter Designations in Front of Section Numbers)

In each code development cycle, proposed changes to this code are considered at the Committee Action Hearings by the applicable International Code Development Committee. The IECC—Commercial Provisions (sections designated with a "C" prior to the section number) are primarily maintained by the Commercial Energy Code Development Committee. The IECC—Residential Provisions (sections designated with an "R" prior to the section number) are maintained by the Residential Energy Code Development Committee. This is designated in the chapter headings by a [CE] and [RE], respectively.

Maintenance responsibilities for the IECC are designated as follows:

[CE] = International Commercial Energy Conservation Code Development Committee
[RE] = International Residential Energy Conservation Code Development Committee

For the development of the 2024 edition of the I-Codes, there will be two groups of code development committees and they will meet in separate years, as shown in the following Code Development Hearings Table.

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IECC COMMERCIAL PUBLIC COMMENT DRAFT #2 UPDATE
JULY 6, 2023

THE FOLLOWING IS AN UPDATE TO THE STRIKETHROUGH/UNDERLINE IECC COMMERCIAL PUBLIC COMMENT DRAFT #2 UPDATED WITH ERRATA FROM PUBLIC COMMENT AND STAFF. ITEMS SHOWN IN BLUE/GRAY ARE APPROVED CHANGES FROM PUBLIC COMMENT DRAFT #1.

CHAPTER 1 [CE] SCOPE AND ADMINISTRATION

User note:

About this chapter: Chapter 1 *establishes the limits of applicability of the code and describes how the code is to be applied and enforced.* ***Chapter 1*** *is in two parts: Part 1—Scope and Application and Part 2—Administration and Enforcement.* ***Section C101*** *identifies what buildings, systems, appliances and equipment fall under its purview and references other I-Codes as applicable. Standards and codes are scoped to the extent referenced.*

The code is intended to be adopted as a legally enforceable document and it cannot be effective without adequate provisions for its administration and enforcement. The provisions of ***Chapter 1*** *establish the authority and duties of the code official appointed by the authority having jurisdiction and also establish the rights and privileges of the design professional, contractor and property owner.*

PART 1—SCOPE AND APPLICATION

SECTION C101
SCOPE AND GENERAL REQUIREMENTS

C101.1 Title. This code shall be known as the *Energy Conservation Code* of **[NAME OF JURISDICTION]**, and shall be cited as such. It is referred to herein as "this code."

C101.2 Scope (Not subject to public input). This code applies to the design and construction of buildings not covered by the scope of the IECC – Residential Provisions.

C101.2.1 Appendices Provisions in the appendices shall not apply unless specifically adopted.

C101.3 Intent (Not subject to public input). The International Energy Conservation Code - Commercial Provisions provide market-driven, enforceable requirements for the design and construction of commercial buildings, providing minimum efficiency requirements for buildings that result in the maximum level of energy efficiency that is safe, technologically feasible, and life cycle cost effective, considering economic feasibility, including potential costs and savings for consumers and building owners, and return on investment. Additionally, the code provides jurisdictions with supplemental requirements, including ASHRAE 90.1, and optional requirements that lead to achievement of zero energy buildings, presently, and through glidepaths that achieve zero energy buildings by 2030 and on additional timelines sought by governments, and achievement of additional policy goals as identified by the Energy and Carbon Advisory Council and approved by the Board of Directors. Requirements contained in the code will include, but not be limited to, prescriptive- and performance-based pathways. The code may include non-mandatory appendices incorporating additional energy efficiency and greenhouse gas reduction resources developed by the Code Council and others. The code will aim to simplify code requirements to facilitate the code's use and compliance rate. The code is updated on a three-year cycle with each subsequent edition providing increased energy savings over the prior edition. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this intent. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

~~C101.5~~C101.4 Compliance. *Residential buildings* shall meet the provisions of IECC—Residential Provisions. *Commercial buildings* shall meet the provisions of

DRAFT

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.

   .

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.

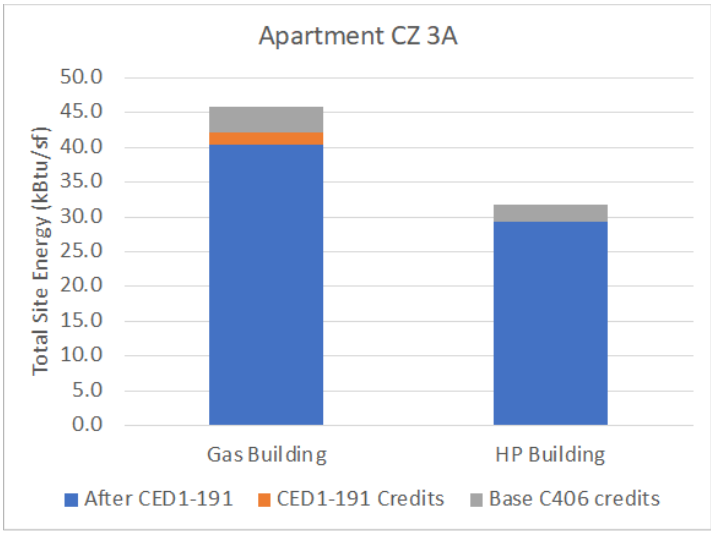
   6.2 The *addition's* total heat pump space heating capacity serving the *addition* is not less than 50% of the *addition's* space heating load at heating design conditions calculated in accordance with Section C403.1.1.

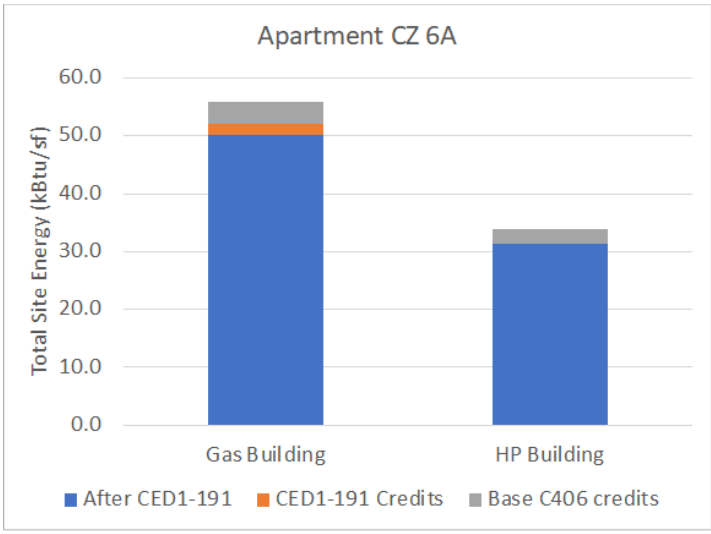
   6.3 Any energy source other than electricity or *on-site renewable energy* is used for space heating serving the *addition* only when a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.

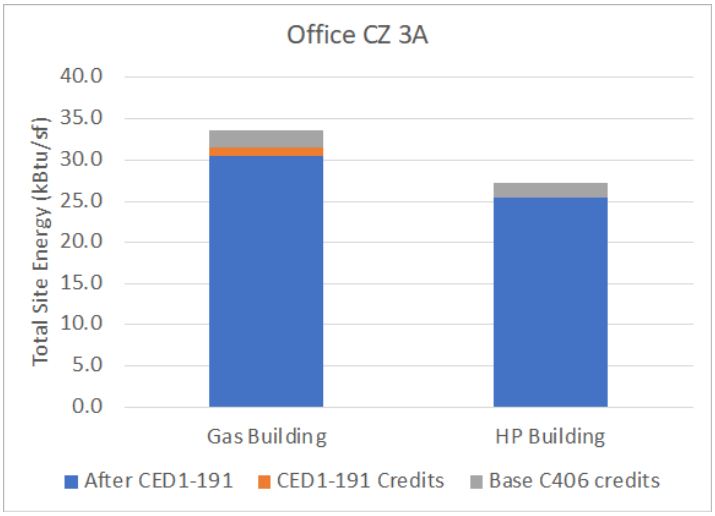
   6.4 Electric resistance heat serving the *addition* is used only in accordance with Section C403.4.1.1.

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

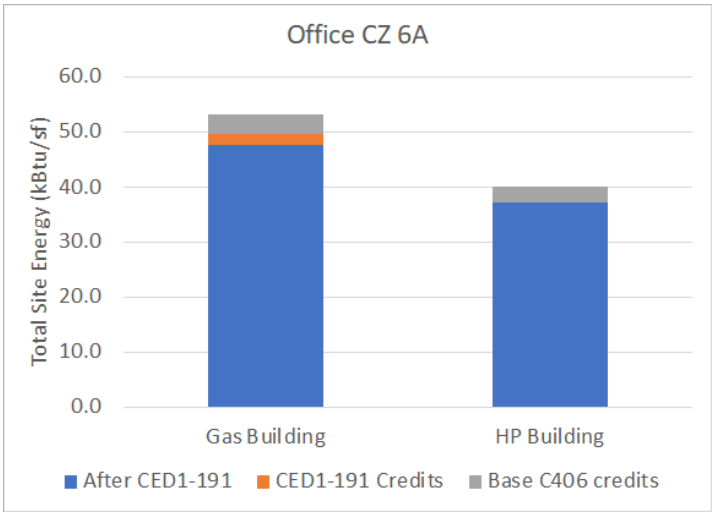

Office CZ 6A
Total Site Energy (kBtu/sf)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Gas Building
HP Building
After CED1-191
CED1-191 Credits
Base C406 credits

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.

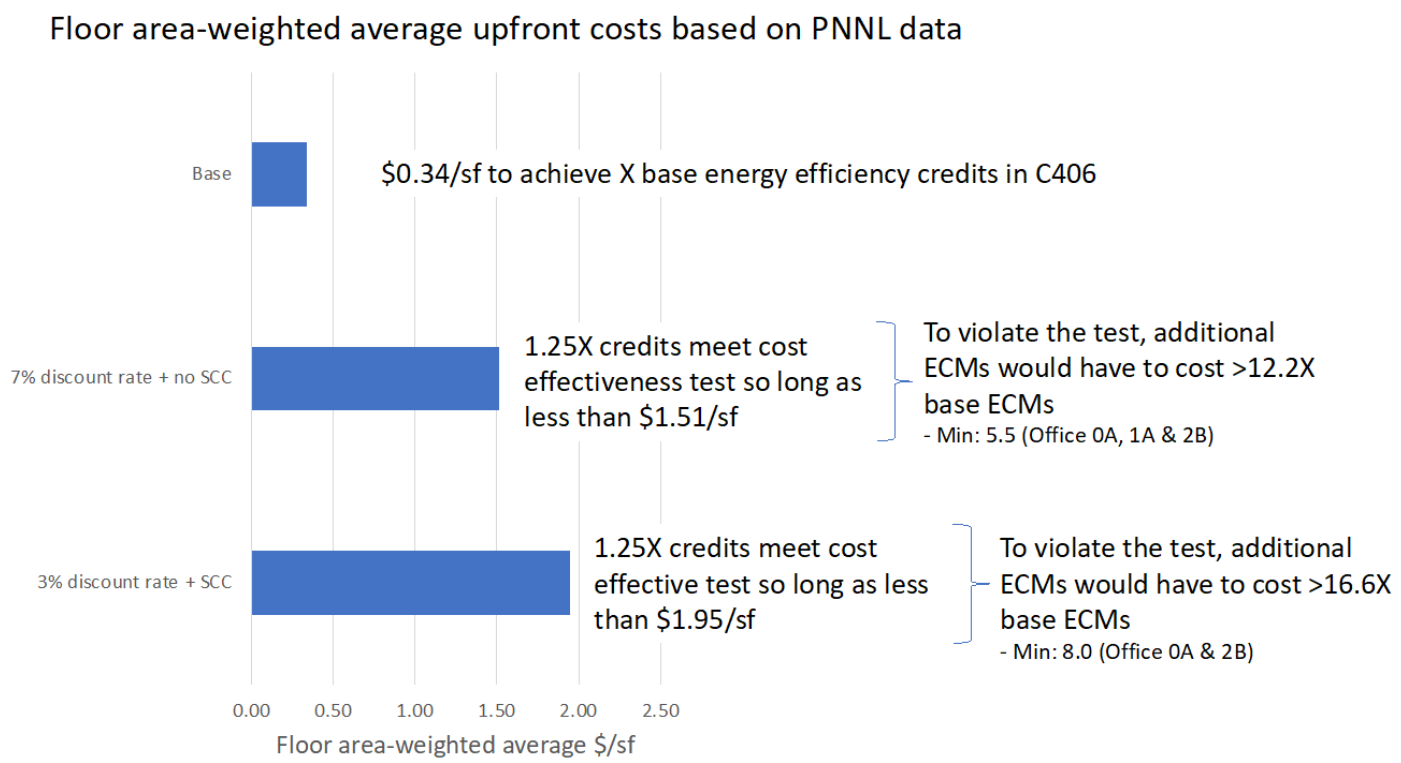


Fig. 2: Cost-effectiveness analysis using PNNL data

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.

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), C406.1.4 (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), C406.2.1.4 (New), C406.2.1.5 (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), SECTION 202 (New), TABLE C406.2.2.5 (New), C406.2.3.1.1 (New), C406.2.3.1.2 (New), C406.2.3.1.3 (New), C406.2.3.1.4 (New), C406.2.5.3.1 (New), C406.2.5.3.2 (New), C406.2.5.3.3 (New), ASTM Chapter 06, AERC (New), IES (New)

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

2021 International Energy Conservation Code

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 (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

C406.1.1.1 Building Core/Shell and Initial 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.

C406.1.2 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 Substantial Alterations to Existing Buildings.

The *building envelope*, *equipment*, and *systems* in *alterations* to *buildings* exceeding 5000 square feet (46.5 m^2) of *gross conditioned floor area* shall comply with the requirements of Section C406.1.1 and C406.1.2 where the alteration includes replacement of two or more of the following:

1. HVAC unitary systems or HVAC central heating or cooling equipment serving the alteration area, not including ductwork or *piping*
2. 80% or more of the lighting fixtures in the *alteration* area
3. Building envelope components in the *alteration* area including new exterior cladding, fenestration, or insulation.

C406.1.4 Energy Credits Achieved.

Energy credits achieved for the project shall be the sum of measure energy credits for individual measures included in the project. Credits are available for the measures listed in Section C406.2. Base energy credits are shown in Tables C406.1.4(1) through C406.1.4(9) based on building occupancies and climate zones. Measure energy credits achieved shall be determined in one of three ways, depending on the measure:

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

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

ID	Energy Credit	Section	Climate Zone

0A	Measure		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	3
E03	Envelope leak reduction	C406.2.1.3	15	10	12	8	6	16	13	5	1	47	7	9	65	16	1	73	43	5
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
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	1
E06	Improve Fenestration	C406.2.1.6	7	7	4	6	9	11	13	3	1	22	5	10	27	18	7	41	33	2
H01	HVAC Performance	C406.2.2.1	20	19	16	17	14	13	11	11	5	13	10	8	15	12	7	18	14	1
H02	Heating efficiency	C406.2.2.2	x	x	x	x	x	x	3	1	1	6	2	3	10	5	2	14	10	1
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
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	1
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	7
W01	SHW preheat recovery	C406.2.3.1a	61	63	74	74	85	88	101	100	121	103	109	122	102	111	130	93	106	9
W02	Heat pump water heater	C406.2.3.1b	50	52	62	61	72	74	86	85	104	88	94	106	88	96	112	81	92	8
W03	Efficient gas water heater	C406.2.3.1c	38	39	46	46	53	55	63	62	76	64	68	76	64	69	81	58	66	6
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
W05	Point of use	C406.2.3.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

	water heaters	a																		
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
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	1
W08	SHW submeters	C406.2.3.4	11	11	13	13	15	16	18	18	22	19	20	22	19	20	24	17	20	1
W09	SHW distribution sizing	C406.2.3.5	45	46	55	54	63	65	74	73	89	75	80	89	74	81	95	68	77	7
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	2
P01	Energy monitoring	C406.2.4	3	3	2	3	2	2	2	2	2	2	2	2	2	2	2	3	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
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
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
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
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
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
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
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
Q03	Residential kitchen	C406.2.7.3	15	15	17	16	17	18	17	18	20	16	17	18	15	16	18	13	15	1

	equip.																			
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

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 leak 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	C406.2.3.1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3

	water heater	b																			
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	C406.2.7.2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

	kitchen equip.																				
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	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 Wall 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	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	C406.2.3.1	18	19	22	22	25	27	31	31	32	34	34	38	37	36	40	36	37	36	35

	recovery	a																			
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 Abbreviated Title	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	0	7	2	3	10	6	4	12	9	19	11
E03	Envelope leak reduction	C406.2.1.3	5	3	4	2	2	2	5	1	0	8	0	2	13	4	0	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 Wall 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	C406.2.2.5	31	31	27	29	25	25	28	26	18	35	28	28	47	38	29	64	53	58	74

	control																				
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	C406.2.5.7	7	7	8	8	8	8	8	8	9	7	8	8	6	7	8	5	6	5	3

	reduction																				
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 measure is not available for building occupancy in that climate zone

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

Portions of table not shown remain unchanged.

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 leak 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
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
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 measure 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	1
E03	Envelope leak reduction	C406.2.1.3	3	3	2	2	3	3	19	3	1	44	6	11	56	13	6	64	44	43	1
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	3
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	1
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	C406.2.2.1	31	30	26	28	22	21	22	20	14	27	21	22	20	25	22	22	28	20	2

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	3
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	3
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	1
W01	SHW preheat recovery	C406.2.3.1a	12	13	16	15	18	20	19	21	26	17	21	21	16	19	21	13	16	15	1
W02	Heat pump water heater	C406.2.3.1b	3	3	4	3	4	5	5	5	7	5	6	6	4	5	6	4	4	4	4
W03	Efficient gas water heater	C406.2.3.1c	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	C406.2.3.3a	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
W06	Thermostatic bal. valves	C406.2.3.3b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
W07	SHW heat trace system	C406.2.3.3c	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	C406.2.5.1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

	Performance																				
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	C406.2.1.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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 distribution sizing	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 measure 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

E03	Envelope leak reduction	C406.2.1.3	2	2	1	2	1	3	31	3	1	77	14	17	92	25	8	95	71	69
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

	trace system	c																		
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
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
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
P01	Energy monitoring	C406.2.4	5	5	6	6	6	6	5	6	6	5	5	5	5	5	6	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
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
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
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
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
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
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
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
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
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

a. "x" indicates measure is not available for 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 distribution sizing	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	C406.2.7.3	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

	Kitchen equip.																				
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 measure 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 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 calculation as stated in the measures 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.

C406.2.1 More Efficient Building Envelope.

A project shall achieve credits for improved envelope performance by complying with 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 E02 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.

$EC_{ENV} = 1000 \times (EPF_B - EPF_P)/EPF_B$

(Equation 4-13)

where:

EC_{ENV} = E01 measure energy credits

EPF_B = base envelope performance factor calculated in accordance with ASHRAE 90.1-2019-Appendix C.

EPF_P = proposed envelope performance factor calculated in accordance with ASHRAE 90.1-2019-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.

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:

$EC_{E03} = EC_B \times EC_{adj}$

(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)

$EC_{adj} = Ls/EC_a$

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 Secction C402.5.2

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

EC_a = 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
	Fixed	Operable		
0-2	0.45	0.52	0.21	0.28
3	0.33	0.44	0.23	0.30
4-5	0.31	0.38	0.34	0.41
6-7	0.26	0.32	0.38	0.44
8	0.24	0.28	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

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.

$EEC_{HEH} = EEC_{H5} \times (HEI / 0.05)$

(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 47ºF (8.3ºC) shall be used.

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

$HEI = (HM_{DES}/HM_{MIN})-1$

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, 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 equipment cooling 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)

   ~~EEC_5~~ 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:

   $CEI = (CM_{DES}/CM_{MIN}) - 1$

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

   $CEI = (CM_{MIN}/CM_{DES}) - 1$

   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 ASHRAE Standard 90.4, CEI shall be calculated as follows:

   $CEI = (AMLC_{MAX}/AMLC_{DES}) - 1$

   Where:

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

   $AMLC_{MAX}$ = Maximum Annualized Mechanical Load Component from ASHRAE 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:

$EC_{DOAS} = EC_{BASE} \times FLOOR_{CAV} \times ERE_{ADJ}$

(Equation 4-18)

where:

EC_{DOAS} = Energy credits achieved for H06

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

$FLOOR_{CAV}$ = 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.

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.

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 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.

C406.2.3.3 Water-heating distribution temperature maintenance.
A project is allowed to claim energy credits from only one of the following SHW distribution temperature maintenance measures.

1. **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 percent 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.
2. **W05 Point of use water heaters**. Credits are available for office or school 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:
   1.1 Non-residential lavatories: not more than 2 oz (60 mL)
   1.2 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.
3. **W06 Thermostatic balancing valves.** Credits are available where service water heating is provided centrally and distributed throughout the building. 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 115°F (46°C).
4. **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 C406.1.2(1) through C406.1.2(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.
W10 credit = W10 base energy credit X (showers with drain heat recovery / total showers in building)
(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 (3.66 m) 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 (3.66 m).
   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. Sheduling 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 Tables C406.1.2(1) through C406.1.2(9) shall be prorated as follows:
[Tuned lighted floor area,%] × [Base energy credits for C406.2.5.2] / 50%

C406.2.5.3 L03 Increase occupancy sensor.
To achieve this credit, automatic partial OFF or automatic full OFF occupancy sensors shall be installed in all space types not required by C405.2.1 and shall be installed as follows:

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:

$EC_{DL} = EC_{DL5} \times 20 \times [(DLA_{BLDG}/GLFA) - DLA_{TYP}]$
(Equation 4-23)
where:
EC_{DL} = 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 % 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 >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 (464 m^2).
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:

$EC_{LPA} = EC_5 \text{ X } 20 \text{ X } (LPA_n - LP_n)/LPA_n$

(Equation 4-24)

where:

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

LP_n = net connected interior lighting power calculated in accordance with Section C405.3.1, 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

EC5 = 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 may 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.

$EC_e = EC_t \text{ x } CR_e$

(Equation 4-25)

where:

EC_e = Elevator energy credit achieved for the *building*

EC_t = 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	

For SI: BTU/h = 0.293W

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	

a. Cooking Energy Efficiency is based on heavy-load (potato) cooking capacity

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	≤ 0.50 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 x SF_{rack}[c] (≤ 0.55 + 0.0046 x SM_{rack}[c])	≤ 0.58 GPR (≤2.2 LPSM)	N/A	N/A	N/A	
Single Tank Conveyor	≤ 1.20 kW	≤0.36 kWh/rack	≤ 0.70 GPR (≤2.6 LPSM)	≤ .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 LPSM)	≤ 1.00 kW	≤0.22 kWh/rack	≤ 0.54 GPR (≤ 2.0 LPR)	
Single Tank Flight Type	Reported	Reported	GPH ≤ 2.975cx + 55.00 (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 meter 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; SFrack (SMrack) 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	≥ 46	ASTM F1496
Electric	Half-Size	≤ 1.0 Btu/h	≥ 71	
	Full-Size	≤ 1.60 Btu/h		
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 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:
[Section C406.2 base credits] × [floor area of guest rooms with kitchens] / [total guest room floor area]
(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 C403.6(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	x	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 = Credits excluded from this *building* use type and 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.

Projects installing on-site renewable energy systems with a capacity of at least 0.1 watts per gross square foot (1.08 W/m2) of building area or securing off-site renewable energy shall achieve energy credits for this measure calculated as follows:

$EC_R = EC_{0.1} \times (R_t + R_{off} - R_{ex}) / (0.1 \times PGFA)$

(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 X 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

Table 406.3.1 Renewable Capacity Limits (RA_L) without Electric Storage, W/ft^2

Building Occupancy Group	Climate Zone																	
	0A	**0B**	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**
RA_{L1}: R-2, R-4, and I-1 with gas water heat [a]	1.3	1.3	1.0	1.0	1.0	0.9	0.9	0.8	0.7	0.9	0.8	0.9	0.9	0.9	0.9	1.0	0.9	1.0
RA_{L2}: R-2, R-4, and I-1 with electric or solar water heat [a]	7.6	6.8	5.9	5.1	4.2	4.2	4.2	3.4	2.5	4.2	3.4	3.4	3.4	3.4	3.4	4.2	3.4	4.2
I-2	10.3	9.7	8.2	8.2	8.2	7.3	7.2	6.2	6.2	7.5	6.2	7.3	7.5	6.5	7.3	7.3	7.2	7.2
R-1	4.1	3.8	3.4	2.9	3.1	2.7	2.6	2.3	2.2	2.7	2.0	2.7	2.7	2.1	1.9	2.6	2.2	2.7
RA_{L3}: B with IT & phone equip. > 0.5 W/ft^2[b]	5.2	5.2	4.6	4.6	4.3	4.0	4.0	3.8	3.5	3.8	3.8	4.0	4.0	4.0	4.0	4.0	4.0	4.3
RA_{L4}: B with IT & phone equip. ≤ 0.5 W/ft^2[b]	2.7	2.7	2.1	2.1	2.1	1.9	1.9	1.6	1.6	1.8	1.6	1.8	1.8	1.8	1.8	1.9	1.9	2.0
A-2	26.9	26.3	19.4	20.0	18.0	14.9	14.9	13.9	12.7	14.8	12.5	14.0	13.7	13.1	13.2	14.4	13.6	14.4
M	6.5	6.4	4.5	4.8	4.3	3.5	3.5	3.0	2.9	3.2	2.9	3.2	3.2	2.9	2.8	3.1	2.9	3.1
E	3.9	4.2	2.8	3.0	2.6	2.1	2.0	1.7	1.6	1.9	1.4	1.9	1.9	1.9	1.9	1.9	1.9	1.9
S-1 and S-2	1.3	1.3	1.0	1.0	0.7	0.7	0.7	0.7	0.6	0.7	0.6	0.7	0.7	0.7	0.7	0.9	0.9	0.9
All Other	3.4	3.3	2.6	2.5	2.9	2.7	2.7	2.1	2.3	2.6	2.3	2.7	2.7	2.5	3.1	3.1	2.8	3.2

a. For buildings that include residential occupancy (Group R-2, R-4 and I-1), RA_L shall be adjusted as follows:
   1. Where 70% or more of service water-heating capacity is gas, $RA_L = RA_{L1}$
   2. Where 70% or more of service water-heating capacity is electric resistance or solar water/pool heating is included with electric resistance backup, use RA_{L2}
   3. Where 70% or more of service water-heating capacity is heat pump water heating, adjust as follows: $RA_L = RA_{L1} + \{ (RA_{L2} - RA_{L1}) / 3 \}$
   4. Where solar water/pool heating is included with gas backup, prorate based on relative capacity as follows: RA_L = [% gas peak capacity] · RA_{L1} + [% solar peak capacity] · RA_{L2}
   5. Where electric water heating is mixed with gas water heating, prorate based on relative capacity as follows: RA_L = [% gas peak capacity] · RA_{L1} + [% electric peak capacity] · RA_{L2}

b. Office (Group B) IT & phone equipment density is calculated based on total building area, not just server and equipment room area, and power for distributed computers or terminals in office areas is not included. Where the total building density of IT & phone equipment is greater than 0.5 W/sf, $RA_L = RA_{L3}$, otherwise $RA_L = RA_{L4}$.

Table C406.3.1 Renewable Capacity LImits (RA_L) without Electric Storage, W/m^2

Building Occupancy Group	Climate Zone																		
	0A	**0B**	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
RA_{L1}: R-2, R-4, and I-1 with gas water heat [a]	14	14	11	11	11	10	10	9	8	10	9	10	10	10	10	11	10	11	14
RA_{L2}: R-2, R-4, and I-1 with electric or solar water heat [a]	82	73	64	55	45	45	45	37	27	45	37	37	37	37	37	45	37	45	55
I-2	111	104	89	88	88	78	78	67	67	81	67	78	81	70	79	78	78	78	94
R-1	44	40	36	31	33	29	28	24	24	29	22	29	29	23	21	28	24	29	34
RA_{L3}: B with IT & phone equip. > 0.5 W/ft^{2}[b]	56	56	50	50	46	43	43	41	38	41	41	43	43	43	43	43	43	46	56
RA_{L4}: B with IT & phone equip. ≤ 0.5 W/ft^{2}[b]	29	29	23	23	23	20	20	17	17	19	17	19	19	19	19	20	20	22	27
A-2	289	283	209	215	193	160	160	150	136	159	135	150	147	141	142	155	147	155	178
M	70	68	48	51	46	38	38	32	31	35	31	35	35	31	30	34	31	33	36
E	42	45	31	32	28	23	22	18	17	21	15	21	21	21	20	21	20	20	26
S-1 and S-2	14	14	11	11	8	8	8	8	6	8	6	8	8	8	8	10	10	10	11
All Other	36	35	28	27	32	29	29	23	24	28	25	29	29	27	34	33	30	35	34

[same footnotes as IP version]

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:

[Installed electric storage capacity, Wh/ft^2 (Wh/m^2)]] / 5 (54) × [C406.3.5 Credits from Tables]

(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:

ECs = EC1.0 x (1.44 X SR + 0.71) / 2.15

(Equation 4-30)

where:

ECs = Cooling Storage credit achieved for Project

EC1.0 = 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 ton-hours storage per design day ton (kWh/kW) of cooling load where 0.5 ≤ SR ≤ 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 70ºF (21ºC) and shall continue uninterrupted until deactivated when outdoor air temperature falls below 45ºF (7ºC). During summer mode, the occupied cooling *set point* shall be set 1ºF (0.6ºC) higher than normal and the occupied heating *set point* shall be reset 2ºF (1.1ºC) 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 5ºF (2.8ºC) 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 50ºF (10ºC) 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.

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 commisioning

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

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 percent 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:

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

Add new definition as follows:

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.

Add new text as follows:

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 Effectivness 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.

C406.2.3.1.1 W01 Recoverd 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 heaters* 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:

$EC_{HPWH} = (EC_{BASE}/0.5) \times \{(CAP_{HPWH})/(ENDLOAD)$ [not greater than 2]}

(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 50ºF (10ºC) entering air and 70ºF (21ºC) 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 67.5ºF (19.7ºC), 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 45ºF (7.2ºC)
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 50ºF (10ºC) entering air and 70ºF (21ºC) 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 x $(HP_{LF}/50\%)$

(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.

C406.2.5.3.1 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
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.

Revise 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

ASTM

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

F1920—~~2015~~2020 Standard Test Method for Performance of Rack Conveyor Commercial Dishwashing Machines

Add new text as follows:

AERC

Attachments Energy Rating Council
355 Lexington Ave 15th Floor
New York, NY 10017

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

IES Illuminating Engineering Society.
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

Reason: 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 40 energy efficiency measures and builds on the former energy credit approaches with a base goal of around 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. Renewable and Load Management measures add cost savings based on grid cost impact represented by a time-of-use electric price structure. While measure goals vary by building type and climate zone, a national weighted goal is as follows:

- The package of cost effective measures achieves a weighted national average of 7.0% site energy savings
- The package of cost effective load management and renewable measures achieves an average of 7.3% utility cost savings

If these measures were adopted nationally into building codes, potential national savings for expected new construction using various metrics would be as given in Table 1 while the impact of renewable and selected load management measures is shown in Table 2.

Table 1. Impact of Energy Credit Measures

Metric[a]	Units	Base Package
National Annual Site Energy Savings	million Btu	7,760,000
Consumer Annual Energy Cost Savings	million $US	$154.0m
Annual Emission Reductions, CO_2	metric tons	995,000

(a) The values shown here are based on national average values. Custom results can be generated for states and local jurisdictions to support adoption of advanced code concepts.

Table 2. Impact of Renewable and Load Management Credit Measures

Metric	Units	Base Package
Consumer Annual Energy Cost Savings	million $US	$158.2m

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

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 C406.2.5.4 *Note to adopting jurisdictions, consider including the following informative note to clarify the requirements of*

C406.2.5.4. In IES LM83, spatial daylight autonomy (sDA) means the amount of daylight received in a space over a portion of operating hours each year. It is written as sDA###,YY% where the ### indicates the desired lux provided by the daylight. The YY% indicates the portion of operating hours per year to receive that daylight. It also includes an area requirement or statement. For example, sDA200,60% for 30% of regularly occupied spaces means that 30% of regularly occupied spaces receive at least 200 lux for at least 60% of the operating hours each year.

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. Other strategies may be implemented that cool the space below the heating setpoint and adjust the morning heating setpoint to avoid morning reheating.*

Section C407.2

The formula above 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.

Coordination with Proposal CEPI-76-21

This proposal includes language that coordinates with proposal CEPI-76-21 HVAC Total System Performance Ratio. Energy Credit H01 described in Section C406.2.2.1 allows projects using TSPR an easy way to document energy credits and is contingent on the approval of CEPI-76-21. The proposed coordinating language includes:

1. Section 406.2.2 numbered list items 1 and 7.

2. Section C406.2.2.1,

3. the base energy credits for H01 in Tables C406.1.4(1) through C406.1.4(9).

If Proposal CEPI-76-21 is not approved for publication in the 2024 IECC then the coordinating language for energy credit H01 needs to be removed from this proposal prior to publication.

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. Two requirement packages were determined for evaluation of cost effectiveness:· The package included standard efficiency measures with a cap of 10% for required credits to allow for measure selection flexibility. While the energy credits are limited to 10% whole-building savings, in many cases the selected measures that were cost effective exceeded that savings level. Table 8 provides an overview of measures selected for inclusion in the package. Measures are selected with the goal of 7% savings or 70 credits for this package. 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.

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 9. This represents the cost for all measures included in the package divided by the annual consumer energy cost savings. Note that for multifamily buildings and hotels, the SHW distribution redesign results in a significant cost reduction, so the overall package cost

is less than the baseline and the "CE" indicates that the packages in those buildings are immediately cost effective. 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 7, weighted by the measure cost savings. The measures included in the base package and therefore 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.

Table 7. Scalar Ratio Method Economic Parameters and Scalar Ratio Limit

Input Economic Variables	Heating (gas) $Rh	Cooling (electricity) $Rc
Economic Life – Years (example)	40	40
Down Payment - $	0.00	0.00
Energy Escalation Rate - %[a]	2.90	2.25
Nominal Discount Rate - %[b]	8.1	8.1
Loan Interest Rate - %	5.0	5.0
Federal Tax Rate - %[b]	NA[b]	NA[b]
State Tax Rate - %[b]	NA[b]	NA[b]
Heating – Natural Gas Price, $/therm	0.983	
Cooling - Electricity Price $/kWh		0.1099
Scalar Ratio Limit (weight: 0.25/0.75)	**25.4**	**22.0**

(a) The energy escalation rate used in the scalar calculation for 90.1-2022 includes inflation, so it is a nominal rather than a real escalation rate.
(b) Beginning with addenda for 90.1-2016, SSPC 90.1 eliminated tax analysis from the Scalar Method by using a pre-tax discount rate.

Table 8. Matrix of Base Package Efficiency Measures

ID	Energy Credit Abbreviated Title	Measure Life, yr	Multifamily /Dormitory	Health Care	Hotel/Motel	Office	Restaurant	Retail	School/ Education	Warehouse/ Semiheated
E01	Glazing U & SHGC reduction	40	CZ 0A-1A	all CZ	all CZ	all CZ			all CZ	
E02	UA Reduction (15%)	40						All CZ		
H02	Heating efficiency	18		CZ 5-8	CZ 5-8	CZ 5-8	CZ 5-8	CZ 5B-8	CZ 5-8	CZ 4C-8
H03	Cooling efficiency.	15	CZ 0-2	CZ 0-2	CZ 0-3B	CZ 0-3B	CZ 0-3B	CZ 0-3B	CZ 0-3B	CZ 0-3B
H04	Residential HVAC control.	15	CZ 0-3, 6-8							
W02	Heat pump water heater	19					30% all CZ	CZ0, 4B-5		
W03	Efficient gas water heater	15	all CZ	all CZ	all CZ	all CZ	70% all CZ		all CZ	
W06	Thermostatic balancing valves	15	all CZ	all CZ	all CZ	all CZ			all CZ	
W08	SHW distribution sizing	15	all CZ		all CZ					
L03	Increase occupancy sensor	15		all CZ						all CZ
L04	Increase daylighting area	15						CZ 0-5		all CZ
L06	Light power reduction	20	5% all CZ	15% all CZ	15% all CZ	15% all CZ	10% all CZ	10% all CZ	15% all CZ	10-15% all CZ
Q02	Efficient kitchen equipment	15	(a)		(a)		all CZ		(a)	
Q04	Fault detection	15		all CZ	all CZ	CZ 0-4			all CZ	

[a] Dining areas and kitchens in dormitories, hotels, and schools treated as a separate area where efficient kitchen equipment credits apply

Table 9. Scalar Ratios for Base Package Efficiency Measures by Climate Zone and Building Type

	Climate Zone																		
Building Use Type	**0A**	**0B**	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
Multifamily/Dormitory	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE
Health Care	3.0	3.3	3.3	3.3	3.2	3.6	2.7	2.8	2.4	2.5	2.6	2.3	2.6	2.6	2.0	2.6	2.5	2.3	2.3
Hotel/Motel	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE	CE
Office	11.7	12.1	13.1	12.7	13.2	13.6	13.3	13.1	12.6	11.0	10.7	11.7	10.9	10.7	11.8	9.6	10.0	9.8	9.1
Restaurant	3.2	3.5	4.2	3.9	4.3	4.7	4.9	4.9	4.9	4.7	4.7	4.7	3.5	3.8	4.0	3.1	3.4	2.8	2.4
Retail Buildings	4.0	4.3	4.8	4.6	5.4	5.5	6.1	6.2	4.9	4.4	5.0	5.3	4.3	4.6	5.2	3.4	4.5	5.1	5.0
School/Education	6.5	7.3	8.5	7.8	8.8	9.8	9.1	9.0	8.0	7.1	7.1	7.8	6.6	6.1	7.2	5.4	6.1	5.2	4.4
Warehouse	8.3	8.1	9.4	8.9	9.8	9.5	8.0	7.7	2.7	2.8	2.7	2.9	1.8	2.4	3.0	1.4	1.8	1.5	1.5

EC147–09/10

202, 101.2, Chapter 5

Proponent: David C. Hewitt, New Buildings Institute, John Loyer, American Institute of Architects, Ronald Majette, representing US Department of Energy

1. Revise as follows:

101.2 Scope. This code applies to *residential* and *commercial buildings* and the building site and associated systems and equipment.

2. Revise as follows:

BUILDING. Any structure used or intended for supporting or sheltering any use or occupancy, including any mechanical systems, service water heating systems and electric power and lighting systems located on the building site and supporting the building.

BUILDING COMMISSIONING. A process that verifies and documents that the selected building systems have been designed, installed, and function according to the owner's project requirements and construction documents, and to minimum code requirements.

BUILDING SITE. A contiguous area of land that is under the ownership or control of one entity.

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floor, roof, and any other building element that encloses *conditioned space*~~. This boundary also includes the boundary between *conditioned space* and any exempt or unconditioned space~~ or provides a boundary between *conditioned space* and exempt or unconditioned space.

CONTINUOUS AIR BARRIER. A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

FENESTRATION PRODUCT, FIELD-FABRICATED is a fenestration product including an exterior glass door whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site-built fenestration with a label certificate or products required to have temporary or permanent labels.

FENESTRATION PRODUCT, SITE-BUILT is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units. Examples of site-built fenestration include storefront systems, curtain walls, and atrium roof systems.

FURNACE ELECTRICITY RATIO. The ratio of furnace electricity use to total furnace energy computed as ratio = $(3.412*E_{AE})/(1000*E_F + 3.412*E_{AE})$, where E_{AE} (average annual auxiliary electrical consumption) and E_F (average annual fuel energy consumption) are defined in Appendix N to subpart B of part 430 of title 10 of the Code of Federal Regulations and E_F is expressed in millions of Btu's per year.

ON-SITE RENEWABLE ENERGY. Energy derived from solar radiation, wind, waves, tides, landfill gas, biomass, or the internal heat of the earth. The energy system providing on-site renewable energy shall be located on or adjacent to the project site.

3. Revise as follows:

501.1 Scope. The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings. ~~These commercial buildings shall meet either requirements of ASHRAE/IESNA Standard 90.1, *Energy Standard for Buildings Except for Low-Rise Residential Buildings*, or the requirements contained in this chapter.~~

4. Revise as follows:

501.2 Application. The *commercial building* project shall comply with the requirements in Sections 502 ~~(Building envelope requirements),~~ 503 ~~(Building mechanical systems)~~, 504~~(Service water heating)~~, 505 ~~(Electrical power and~~

~~lighting systems)~~ in its entirety, and one of the additional options as presented in Section 506. As an alternative the *commercial building* project shall exceed by at least 25% ~~comply with~~ the requirements of ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except for Low Rise Residential Buildings, Appendix G in its entirety.

Exceptions:

1. Buildings conforming to Section 507, provided Sections 502.4, 503.2, 504, 505.2, 505.3, 505.4, 505.6 and 505.7 are each satisfied. Building energy cost shall be equal to or less than 75% of the standard reference design building.
2. Additions, alterations and repairs shall comply with the applicable requirements in Sections 502, 503, 504, and 505 only or with ASHRAE/IESNA 90.1.

5. Revise as follows:

502.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table 502.2(1), based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

Exception: Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted *U*-factor is equivalent to the same assembly with the *R*-value specified in Table 502.2(1).

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

6. Add new text as follows:

502.2.1.1 Roof solar reflectance and thermal emittance. Roofs in climate zones 1 to 3 not over ventilated attics or not over cooled spaces shall have a minimum three-year aged - solar reflective index (SRI) of 64 when determined in accordance with the SRI method in ASTM E1980 using a convection coefficient of ($12W/m^2 \cdot K$) or a minimum three-year-aged solar reflectance of 0.55 when tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 and a minimum three-year-aged thermal emittance of at least 0.75 when testing in accordance with ASTM C1371 or ASTM E408.

Exceptions:

1. Ballasted roofs with a minimum stone ballast of 17 lbs/ft2 (74 kg/m2) or 23 lbs/ft2 pavers (117 kg/m2).
2. Roofs, where a minimum of 75% of the roof area is shaded during the peak sun angle on June 21st by permanent features of the building and/or is covered by off-set photovoltaic arrays, building-integrated photovoltaic arrays, or solar water collectors.
3. Metal building roofs or asphaltic membranes in climate zone 3.

7. Revise as follows:

502.2.6 Slabs on grade. The minimum thermal resistance (*R*-value) of the insulation around the perimeter of unheated or heated slab-on-grade floors shall be as specified in Table 502.2(1). The insulation shall be placed on the outside of the foundation or on the inside of ~~a~~ the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Where extending outside of the foundation the insulation shall be covered by pavement or by soil a minimum of 10 in. thick. For the purposes of this section a slab on grade floor is a slab floor that is in contact with the ground and that is either above grade or less than or equal to 24 in. below the final elevation of the nearest exterior grade.

8. Revise Table as follows:

TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration (~~40~~ 30% maximum of above-grade wall)								
U-factor								

(Portions of Table not shown, remain unchanged)

9. Delete and substitute as follows:

~~**502.4.1 Window and door assemblies.** The air leakage of window and sliding or swinging door assemblies that are part of the building envelope shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, or NFRC 400 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer and shall not exceed the values in Section 402.4.2.~~

~~**Exception:** Site-constructed windows and doors that are weatherstripped or sealed in accordance with Section 502.4.3.~~

~~**502.4.2 Curtain wall, storefront glazing and commercial entrance doors.** Curtain wall, *storefront* glazing and commercial- glazed swinging entrance doors and revolving doors shall be tested for air leakage at 1.57 pounds per square foot (psf) (75 Pa) in accordance with ASTM E 283. For curtain walls and *storefront* glazing, the maximum air leakage rate shall be 0.3 cubic foot per minute per square foot (cfm/ft^2) (5.5 m^3/h × m^2) of fenestration area. For commercial glazed swinging entrance doors and revolving doors, the maximum air leakage rate shall be 1.00 cfm/ft^2 (18.3 m^3/h × m^2) of door area when tested in accordance with ASTM E 283.~~

~~**502.4.3 Sealing of the building envelope.** Openings and penetrations in the building envelope shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seams shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.~~

502.4.1 Air Barriers. The building envelope shall be designed and constructed with a continuous air barrier that complies with Section 502.4.1.1 and 502.4.1.2 to control air leakage into, or out of, the conditioned space. Construction documents shall identify the air barrier components for each assembly, including detailing joints, interconnections and sealing of penetrations. The opaque building envelope air barrier shall be located on the inside or, outside of, or be integral with the building envelope; or any combination thereof.

Exception: Buildings in climate Zones 1, 2 and 3.

502.4.1.1 The *continuous air barrier* shall have the following characteristics:

1. It shall be continuous throughout the envelope (at the lowest *floor*, exterior *walls*, and ceiling or *roof*). Air barrier joints and seams shall be sealed; including sealing transitions in planes and changes in materials. Air barrier penetrations shall be sealed.
2. The air barrier component of each assembly shall be joined and sealed in a flexible manner to the air barrier component of adjacent assemblies. The joints and seals shall allow for the relative movement of the assemblies and materials without damage to the air seal.
3. The air barrier shall be installed in accordance with the *manufacturer's* instructions in a manner that achieves the performance requirements.
4. Where lighting *fixtures* with ventilation holes or other similar objects are to be installed in such a way as to penetrate the *continuous air barrier*, provisions shall be made to maintain the integrity of the *continuous air barrier.*

Exception: Buildings that comply with Section 502.4.1.2(3) below are not required to comply with either 1 or 4.

502.4.1.2 Air barrier compliance options. A continuous air barrier for the opaque building envelope shall meet the requirements of at least one of the compliance options in Section 502.4.1.2.1, 502.4.1.2.2, or 502.4.1.2.3

502.4.1.2.1 Materials. Individual materials shall have an air permeability not to exceed 0.02 L/s·m^2 under a pressure differential of 75 Pa (0.004 cfm/ft^2 under a pressure differential of 0.3 in. water (1.57 lb/ft^2)) when tested in accordance with ASTM E2178. The following materials comply with this requirement when all joints are sealed:

1. Plywood - minimum 3/8 in (10 mm)
2. Oriented strand board - minimum 3/8 in (10 mm)
3. Extruded polystyrene insulation board - minimum 3/4 in (19 mm)
4. Foil-back urethane insulation board - minimum 3/4 in (19 mm)
5. Closed cell spray foam meeting air permeability requirement
6. Open cell spray foam meeting air permeability requirement
7. Weather resistant barrier meeting air permeability requirement
8. Exterior or interior gypsum board - minimum 1/2 in (12 mm)
9. Cement board - minimum 1/2 in (12 mm)
10. Built up roofing membrane
11. Modified bituminous roof membrane
12. Fully adhered single-ply roof membrane
13. A Portland cement/sand parge, or gypsum plaster minimum 5/8 in (16 mm) thick
14. Cast-in-place and precast concrete.
15. Fully grouted concrete block masonry.
16. Sheet steel or aluminum

502.4.1.2.2 Assemblies. Assemblies of materials and components shall have an average air leakage not to exceed 0.2 L/s·m2 @ 75 Pa (0.04 cfm/ft2 under a pressure differential of 0.3" w.g. (1.57psf)) when tested in accordance with ASTM E2357 or ASTM E1677. The following assemblies comply with this requirement when all joints are sealed and every characteristic in Section 502.4.4.1.1 is met:,

1. Concrete masonry walls coated with one application either of block filler and two applications of a paint or sealer coating;
2. A Portland cement/sand parge, stucco or plaster minimum 1/2 in (12 mm) thick.

502.4.1.2.3 Building Test. The completed building shall be tested and the air leakage rate of the *building envelope* shall not exceed 2.0 L/s·m^2 @ 75 Pa (0.40 cfm/ft^2 at a pressure differential of 0.3" w.g. (1.57 psf)) in accordance with ASTM E779 or an equivalent method approved by the code official.

502.4.2 Air Barrier Penetrations. All penetrations of the air barrier and paths of air infiltration / exfiltration shall be made air tight and shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seals shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.

502.4.3 Fenestration and doors. The air leakage of fenestration assemblies and doors shall meet the provisions of Table 502.4.3. Testing shall be performed in accordance with the applicable reference test standard by an accredited and independent testing laboratory and all fenestration assemblies *listed* and *labeled*.

Exception: Site built fenestration assemblies that are sealed in accordance with Section 502.4.1.

10. Add new Table as follows:

Table 502.4.3
Maximum Air Infiltration Rate for Fenestration Assemblies

Fenestration Assembly	Maximum Rate
Windows	0.20 [a]
Sliding Doors	0.20 [a]
Swinging Doors	0.20 [a]
Skylights	0.20 [a]
Curtain Walls	0.06 [b]
Storefront Glazing	0.06 [b]
Commercial Glazed Swinging Entrance Doors	1.00 [c]
Revolving Doors	1.00 [c]
Rolling doors	1.00 [c]

a. cfm per square foot of fenestration or door area when tested in accordance with NFRC 400 or AAMA/WDMA/CSA101/I.S.2/A440 at 1.57 psf (75 Pa). Alternatively the maximum rate is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa)
b. cfm per square foot of fenestration area when tested in accordance with NFRC 400 or ASTM E283 at 1.57 psf (75 Pa)
c. cfm per square foot of fenestration or door area when tested in accordance with NFRC 400, AAMA/WDMA/CSA101/I.S.2/A440, or ASTM E283 at 1.57 psf (75 Pa)

11. Add new text as follows:

502.4.4 Doors and Access Openings to Shafts, Chutes, Stairwells, and Elevator Lobbies. These doors and access openings shall either meet the requirements of 502.4.3 or shall be equipped with weather seals.

Exception: Weatherseals on elevator lobby doors are not required when a smoke control system is installed.

12. Revise Section 502.4.5 as follows:

502.4.5 Outdoor air intakes and exhaust openings. Stair and elevator shaft vents and other outdoor air intakes and exhaust openings ~~integral to the building envelope shall be equipped with not less than a Class I motorized dampers, leakage- rated damper with a maximum leakage rate of 4 cfm per square foot (6.8 L/s · C m2) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D~~ shall be provided with dampers in accordance with Sections 502.4.5.1 and 502.4.5.2.

Dampers shall be installed with controls so that they are capable of automatically opening upon:

1. The activation of any fire alarm initiating device of the building's fire alarm system;
2. The interruption of power to the damper.

502.4.5.1 Stair and shaft vents. Stair and shaft vents shall be provided with Class IA motorized dampers with a maximum leakage rate of 3 cfm per square foot (5.1 L/s · C m2) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D.

502.4.5.2 Outdoor air intakes and exhausts. *Outdoor air* supply and exhaust openings shall be provided with Class IA motorized dampers with a maximum leakage rate of 3 cfm per square foot (5.1 L/s · C m2) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D.

Exception: Gravity (nonmotorized) dampers having a maximum leakage rate of 20 cfm per square foot (34 L/s · C m2) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D are permitted to be used ~~in buildings less than three stories in height above grade~~ where the design *outdoor air* intake or exhaust capacity does not exceed 300 cfm.

13. Revise Section 502.4.8 as follows:

502.4.8 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as having an air leakage rate or no more 2.0 cfm (0.944 L/s) ~~meeting ASTM E 283~~ when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential ~~with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity~~. All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

14. Revise as follows:

503.2.1 Calculation of heating and cooling loads. Design loads shall be determined in accordance with the procedures described in the ASHRAE/ACCA Standard 183. The design loads shall account for the building envelope, lighting, ventilation and occupancy loads based on the project design. Heating and cooling loads shall be adjusted to account for load reductions that are achieved when energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*. Alternatively, design loads shall be determined by an *approved* equivalent computation procedure, using the design parameters specified in Chapter 3.

15. Revise as follows:

503.2.2 Equipment and system sizing. ~~Equipment and system sizing.~~ The output capacity of ~~H~~heating and cooling equipment and systems ~~capacity~~ shall not exceed the loads calculated in accordance with Section 503.2.1. A single

piece of equipment providing both heating and cooling must satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

16. Add new text as follows:

503.2.4.3.3 Automatic start capabilities. Controls designed to automatically adjust the start time of an HVAC system each day to allow for automatically brining the space to desired occupied temperature levels immediately before scheduled occupancy shall be provided on each system.

17. Revise as follows:

503.2.5.1 Demand controlled ventilation. Demand control ventilation (DCV) is required for spaces larger than 500 ft^2 ($50m^2$) and with an average occupant load of ~~40~~ 25 people per 1000 ft^2($93\ m^2$) of floor area (as established in Table 403.3 of the *International Mechanical Code*) and served by systems with one or more of the following:

1. An air-side economizer;
2. Automatic modulating control of the outdoor air damper; or
3. A design outdoor airflow greater than 3,000 cfm (1400 L/s).

Exceptions:

1. Systems with energy recovery complying with Section 503.2.6.
2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.
3. System with a design outdoor airflow less than 1,200 cfm (600 L/s).
4. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (600 L/s).
5. Building spaces where the primary ventilation needs are for process loads.

18. Revise Section 503.2.6 as follows:

503.2.6 Energy recovery ventilation systems. ~~Individual fan systems that have both a design supply air capacity of 5,000 cfm (2.36 m3/s) or greater and a minimum outside air supply of 70 percent or greater of the design supply air quantity shall have an energy recovery system that provides a change in the enthalpy of the outdoor air supply of 50 percent or more of the difference between the outdoor air and return air at design conditions. Provision shall be made to bypass or control the energy recovery system to permit cooling with outdoor air where cooling with outdoor air is required.~~ Each fan system shall have an energy recovery system when the system's supply airflow rate exceeds the value listed in Table 503.2.6 based on the climate zone and percentage of *outdoor air* at design conditions. Required energy recovery systems shall have the capability to provide a change in the enthalpy of the *outdoor air* supply equal to at least 50% of the difference between the *outdoor air* and return air enthalpies at design conditions. Provision shall be made to bypass or control the energy recovery system to permit air economizer operation as required by Section 503.4

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the *International Mechanical Code*.
2. Laboratory fume hood systems that include at least one of the following features:
   2.1. Variable-air-volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values.
   2.2. Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (1.1°C) above room setpoint, cooled to no cooler than 3°F (1.7°C) below room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Systems serving spaces that are not cooled and are heated to less than 60°F (15.5°C).
4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy.
5. ~~Heating systems in climates with less than 3,600 HDD.~~ Heating energy recovery in climate zones 1 and 2.
6. ~~Cooling systems in climates with a 1-percent cooling design wet-bulb temperature less than 64_F (18_C).~~
6. Cooling energy recovery in climate zones 3c, 4c, 5b, 5c, 6b, 7, and 8.
7. Systems requiring dehumidification that employ series-style energy recovery coils wrapped around the cooling coil.

Table 503.2.6 Energy Recovery Requirement

Zone	% *Outdoor* air at full design airflow rate					
	≥30% and < 40%	≥40% and < 50%	≥50% and < 60%	≥60% and < 70%	≥70% and < 80%	≥80%
	Design Supply Fan airflow rate (cfm)					
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	≥5000	≥5000
1B, 2B,5C	NR	NR	≥26000	≥12000	≥5000	≥4000
6B	≥11000	≥5500	≥4500	≥3500	≥2500	≥1500
1A, 2A, 3A, 4A, 5A, 6A	≥5500	≥4500	≥3500	≥2000	≥1000	>0
7,8	≥2500	≥1000	>0	>0	>0	>0

19. Delete and substitute as follows:

~~**503.2.9 HVAC system completion.** Prior to the issuance of a certificate of occupancy, the design professional shall provide evidence of system completion in accordance with Sections 503.2.9.1 through 503.2.9.3.~~

~~**503.2.9.1 Air system balancing.** Each supply air outlet and *zone* terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the *International Mechanical Code*. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 horsepower (hp) (7.4 kW) and larger.~~

~~**503.2.9.2 Hydronic system balancing.** Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections.~~

~~**503.2.9.3 Manuals.** The construction documents shall require that an operating and maintenance manual be provided to the building owner by the mechanical contractor. The manual shall include, at least, the following:~~

~~1. Equipment capacity (input and output) and required maintenance actions.~~
~~2. Equipment operation and maintenance manuals.~~
~~3. HVAC system control maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings, at control devices or, for digital control systems, in programming comments.~~
~~4. A complete written narrative of how each system is intended to operate.~~

503.2.9 Mechanical systems commissioning and completion requirements. Mechanical systems commissioning and completion shall be in accordance with the provisions of Section 503.2.9.1 through 503.2.9.3.4.

503.2.9.1 System commissioning. The construction documents shall require commissioning and completion requirements in accordance with this section. The construction documents shall be permitted to refer to equipment specifications for further requirements. Copies of all documentation shall be given to the owner by the registered design professional. The building official may request commissioning documentation for review purposes. At the time of plan submittal, the *code official* shall be provided, by the permitee, a letter of intent to commission the building in accordance with this code.

503.2.9.1.1 Commissioning plan. A commissioning plan shall be prepared and shall include as a minimum the following items:

1. A detailed explanation of the building's project requirements for mechanical design,
2. A narrative describing the activities that will be accomplished during each phase of commissioning, including guidance on who accomplishes the activities and how they are completed,
3. Equipment and systems to be tested, including the extent of tests,
4. Functions to be tested (for example calibration, economizer control, etc.),
5. Conditions under which the test shall be performed (for example winter and summer design conditions, full outside air, etc.), and
6. Measurable criteria for acceptable performance.

503.2.9.1.2 Systems adjusting and balancing. All HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within 10% of design rates. Test and balance activities shall include as a minimum the following items:

1. Air systems balancing: Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the International Mechanical Code. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (18.6 kW) and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, Fan speed shall be adjusted to meet design flow conditions.

   Exception: Fans with fan motors of 1 hp or less.

2. Hydronic systems balancing: Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.

   Exceptions:

   1. Pumps with pump motors of 5 hp or less.
   2. When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed.

503.2.9.1.3 Functional performance testing. Equipment functional performance testing shall be in accordance with Section 503.2.9.1.3.1. Functional testing of HVAC controls shall be in accordance with Section 503.2.9.1.3.2.

503.2.9.1.3.1 Equipment functional performance testing. Equipment functional performance testing shall demonstrate the correct installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications. This demonstration is to prove the operation, function, and maintenance serviceability for each of the commissioned systems. Testing shall include all modes of operation, including:

1. All modes as described in the Sequence of Operation,
2. Redundant or automatic back-up mode,
3. Performance of alarms, and
4. Mode of operation upon a loss of power and restored power.

   Exception: Unitary or packaged HVAC equipment listed in Tables 503.2.3 (1) through (3) that do not require supply air economizers.

503.2.9.1.3.2 Controls functional performance testing. HVAC control systems shall be tested to document that control devices, components, equipment, and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.

503.2.9.1.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and provided to the building owner. The report shall be identified as “Preliminary Commissioning Report” and shall identify:

1. Itemization of deficiencies found during testing required by this section which have not been corrected at the time of report preparation and the anticipated date of correction.
2. Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.
3. Climatic conditions required for performance of the deferred tests, and the anticipated date of each deferred test.

503.2.9.2 Acceptance. Buildings, or portions thereof, required to comply with this section shall not be issued a final certificate of occupancy until such time that the *code official* has received a letter of transmittal from the building owner that states they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the code official, a copy of the Preliminary Commissioning Report shall be made available for review.

503.2.9.3 Completion requirements. The construction documents shall require that within 90 days of system acceptance by the *code official*, the documents described in Section 503.2.9 .3.1 and 503.2.9.3.2 shall be provided to the building owner or their designated representative by the mechanical contractor.

503.2.9.3.1 Drawings. Construction documents shall include as a minimum the location and performance data on each piece of equipment.

503.2.9.3.2 Manuals. An operating manual and a maintenance manual shall be in accordance with industry-accepted standards and shall include, at a minimum, the following:

1. Capacity (input and output) and required maintenance actions for each piece of equipment.
2. Operation and maintenance manuals for each piece of equipment.
3. Manufacturer's operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
4. Names and addresses of at least one service agency.
5. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.
6. A complete narrative of how each system is intended to operate, including ~~suggested~~ recommended setpoints.

503.2.9.3.3 System balancing report. A written report describing the activities and measurements completed in accordance with Section 503.2.9.1.2

503.2.9.3.4 Final Commissioning Report. A complete report of test procedures and results identified as "Final Commissioning Report" shall include:

1. Results of all Functional Performance Tests.
2. Disposition of all deficiencies found during testing, including details of corrective measures used or proposed.
3. All Functional Performance Test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

   Exception: Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.

20. Revise as follows:

TABLE 503.2.10.1(1)
FAN POWER LIMITATION
(No change to Table)

where:

CFMS = The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.
Hp = The maximum combined motor nameplate horsepower.
Bhp = The maximum combined fan brake horsepower.
A = Sum of [*PD* _ CFMD / 4131].

where:

PD = Each applicable pressure drop adjustment from Table 503.2.10.1(2) in. w.c.
CFM_D – The design airflow through each applicable device from Table 503.2.10.1(2) in cubic feet per minute.

21. Revise Section 503.3 as follows:

503.3 Simple HVAC systems and equipment (Prescriptive). This section applies to buildings served by unitary or packaged HVAC equipment listed in Tables 503.2.3(1) through 503.2.3(5), each serving one *zone* and controlled by a single thermostat in the zone served. It also applies to two-pipe heating systems serving one or more zones, where no cooling system is installed.

~~This section does not apply to fan systems serving multiple zones, nonunitary or nonpackaged HVAC equipment and systems or hydronic or steam heating and hydronic cooling equipment and distribution systems that provide cooling or cooling and heating which are covered by Section 503.4.~~

503.3.1 Economizers. ~~Supply air economizers shall be provided on each cooling system as shown in Table 503.3.1(1).~~

~~Economizers shall be capable of providing 100-percent outdoor air, even if additional mechanical cooling is required to meet the cooling load of the building. Systems shall provide a means to relieve excess outdoor air during economizer operation to prevent over-pressurizing the building. The relief air outlet shall be located to avoid recirculation into the building. Where a single room or space is supplied by multiple air systems, the aggregate capacity of those systems shall be used in applying this requirement.~~

~~**Exceptions:**~~

1. ~~Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(1) or 503.2.3(2) and meets or exceeds the minimum cooling efficiency requirement (EER) by the percentages shown in Table 503.3.1(2).~~
2. ~~Systems with air or evaporatively cooled condensers and which serve spaces with open case refrigeration or that require filtration equipment in order to meet the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.~~

Each cooling system that has a fan shall include either an air or water economizer meeting the requirements of Sections 503.3.1.1 through 503.4.1.4.

Exceptions: Economizers are not required for the systems listed below.

1. Individual fan-cooling units with a supply capacity less than the minimum listed in Table 503.3.1(1).
2. Systems that require filtration equipment in order to meet the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code.*
3. Where more than 25% of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F dew-point temperature to satisfy process needs.
4. Systems that include a condenser heat recovery system required by Section 503.4.6.
5. Systems that serve *residential* spaces where the system capacity is less than five times the requirement listed in Table 503.3.1(1).
6. Systems that serve spaces whose sensible cooling load at design conditions, excluding transmission and infiltration loads, is less than or equal to transmission and infiltration losses at an outdoor temperature of 60°F.
7. Systems expected to operate less than 20 hours per week.
8. Where the use of *outdoor air* for cooling will affect supermarket open refrigerated casework systems.
9. Where the cooling *efficiency* meets or exceeds the *efficiency* requirements in Table 503.3.1(2).

TABLE 503.3.1(1)
ECONOMIZER REQUIREMENTS

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B, 2A, 7, 8	No requirement
2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B	Economizers on all cooling systems ≥ 54,000 Btu/h[a]

For SI: 1 British thermal unit per hour = 0.293 W.

a. The total capacity of all systems without economizers shall not exceed480,000 Btu/h per building, or 20 percent of its air economizer capacity, whichever is greater.

TABLE 503.3.1(2)
EQUIPMENT EFFICIENCY PERFORMANCE
EXCEPTION FOR ECONOMIZERS

CLIMATE ZONES	COOLING EQUIPMENT PERFORMANCE IMPROVEMENT (EER OR IPLV)
2B	10% Efficiency Improvement
3B	15% Efficiency Improvement
4B	20% Efficiency Improvement

~~**503.4.1 Economizers.** Supply air economizers shall be provided on each cooling system according to Table 503.3.1(1). Economizers shall be capable of operating at 100 percent outside air, even if additional mechanical cooling is required to meet the cooling load of the building.~~

~~**Exceptions:**~~

1. ~~Systems utilizing water economizers that are capable of cooling supply air by direct or indirect evaporation or both and providing 100 percent of the expected system cooling load at outside air temperatures of 50°F (10°C) dry bulb/45°F (7°C) wet bulb and below.~~
2. ~~Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(1), 503.2.3(2), or 503.2.3(6) and meets or exceeds the minimum EER by the percentages shown in Table 503.3.1(2)~~
3. ~~Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(7) and meets or exceeds the minimum integrated part load value (IPLV) by the percentages shown in Table 503.3.1(2).~~

503.3.1.1 Air Economizers. Air econimizers shall be designed in accordance with Sections 503.3.1.1.1 through 503.3.1.1.4.

503.3.1.1.1 Design Capacity. Air economizer systems shall be capable of modulating *outdoor air* and return air dampers to provide up to 100% of the design supply air quantity as *outdoor air* for cooling.

503.3.1.1.2 Control Signal. Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall not be controlled by only mixed air temperature.

Exception: The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single-zone systems).

503.3.1.1.3 High-Limit Shutoff. All air economizers shall be capable of automatically reducing *outdoor air* intake to the design minimum *outdoor air* quantity when *outdoor air* intake will no longer reduce cooling energy usage. High-limit shutoff control types for specific climates shall be chosen from Table 503.3.1.1.3(1). High-limit shutoff control settings for these control types shall be those listed in Table 503.3.1.1.3(2).

TABLE 503.3.1.1.3(1)
HIGH-LIMIT SHUTOFF CONTROL OPTIONS FOR AIR ECONOMIZERS

CLIMATE ZONES	ALLOWED CONTROL TYPES	PROHIBITED CONTROL TYPES
1b, 2b, 3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8	Fixed dry bulb Differential dry bulb Electronic enthalpy[a] Differential enthalpy Dew-point and dry-bulb temperatures	Fixed enthalpy
1a, 2a, 3a, 4a	Fixed dry bulb Fixed enthalpy Electronic enthalpy[a] Differential enthalpy Dew-point and dry-bulb temperatures	Differential dry bulb
All other climates	Fixed dry bulb Differential dry bulb Fixed enthalpy Electronic enthalpy[a] Differential enthalpy Dew-point and dry-bulb temperatures	-

a. Electronic enthalpy controllers are devices that use a combination of humidity and dry-bulb temperature in their switching algorithm.

TABLE 503.3.1.1.3(2)
HIGH-LIMIT SHUTOFF CONTROL SETTING FOR AIR ECONOMIZERS

DEVICE TYPE	CLIMATE	REQUIRED HIGH LIMIT (ECONOMIZER OFF WHEN):	
		EQUATION	DESCRIPTION
Fixed dry bulb	1b, 2b, 3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8,	T_{OA}>75°F	Outdoor air temperature exceeds 75°F
	5a, 6a, 7a	T_{OA}>70°F	Outdoor air temperature exceeds 70°F
	All other zones	T_{OA}>65°F	Outdoor air temperature exceeds 65°F
Differential dry bulb	1b, 2b, 3b, 3c, 4b, 4c, 5a, 5b, 5c, 6a, 6b, 7, 8	$T_{OA}>T_{RA}$	Outdoor air temperature exceeds return air temperature
Fixed enthalpy	All	h_{OA}> 28 Btu/lb[a]	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[a]
Electronic Enthalpy	All	$(T_{OA}, RH_{OA}) > A$	Outdoor air temperature/RH exceeds the "A" setpoint curve[b]
Differential enthalpy	All	$h_{OA}> h_{RA}$	Outdoor air enthalpy exceeds return air enthalpy
Dew-point and dry bulb temperatures	All	$DP_{OA}>55$°F or $T_{OA}>75$°F	Outdoor air dry bulb exceeds 75°F or outside dew point exceeds 55°F (65 gr/lb)

a. At altitudes substantially different than sea level, the Fixed Enthalpy limit shall be set to the enthalpy value at 75°F and 50% relative humidity. As an example, at approximately 6000 ft elevation the fixed enthalpy limit is approximately 30.7 Btu/lb.

b. Setpoint "A" corresponds to a curve on the psychometric chart that goes through a point at approximately 75°F and 40% relative humidity and is nearly parallel to dry-bulb lines at low humidity levels and nearly parallel to enthalpy lines at high humidity levels.

503.3.1.1.4 Relief of Excess Outdoor Air. Systems shall provide a means to relieve excess *outdoor air* during air economizer operation to prevent over-pressurizing the building. The relief air outlet shall be located to avoid recirculation into the building.

22. Delete and substitute as follows:

~~**503.4.1 Economizers.** Supply air economizers shall be provided on each cooling system according to Table 503.3.1(1). Economizers shall be capable of operating at 100 percent outside air, even if additional mechanical cooling is required to meet the cooling load of the building~~.

~~**Exceptions:**~~

1. ~~Systems utilizing water economizers that are capable of cooling supply air by direct or indirect evaporation or both and providing 100 percent of the expected system cooling load at outside air temperatures of 50°F (10°C) dry bulb/45°F (7°C) wet bulb and below.~~
2. ~~Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(1), 503.2.3(2), or 503.2.3(6) and meets or exceeds the minimum EER by the percentages shown in Table 503.3.1(2)~~
3. ~~Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(7) and meets or exceeds the minimum integrated part load value (IPLV) by the percentages shown in Table 503.3.1(2).~~

503.4.1 Economizers. Economizer systems for complex HVAC Equipment shall be designed in accordance with Sections 503.4.1.1 through 503.4.1.4.

503.4.1.1 Design Capacity. Water economizer systems shall be capable of cooling supply air by indirect evaporation and providing up to 100% of the expected system cooling load at *outdoor air* temperatures of 50°F dry bulb/45° wet bulb and below.

Exception: Systems in which a water economizer is used and where dehumidification requirements cannot be met using outdoor air temperatures of 50°F dry bulb/ 45°F wet bulb must satisfy 100% of the expected system cooling load at 45°F dry bulb/40°F wet bulb.

503.4.1.2 Maximum Pressure Drop. Pre-cooling coils and water-to-water heat exchangers used as part of a water economizer system shall either have a water-side pressure drop of less than 15 ft of water or a secondary loop shall be created so that the coil or heat exchanger pressure drop is not seen by the circulating pumps when the system is in the normal cooling (non-economizer) mode.

503.4.1.3 Integrated Economizer Control. Economizer systems shall be integrated with the mechanical cooling system and be capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

Exceptions:

1. Direct expansion systems that include controls that reduce the quantity of *outdoor air* required to prevent coil frosting at the lowest step of compressor unloading, provided this lowest step is no greater than 25% of the total system capacity.
2. Individual direct expansion units that have a rated cooling capacity less than 54,000 Btu/h and use non-integrated economizer controls that preclude simultaneous operation of the economizer and mechanical cooling.
3. Systems in climate zones 1A, 1B, 2A, 7, 8.

503.4.1.4 Economizer Heating System Impact. HVAC system design and economizer controls shall be such that economizer operation does not increase the building heating energy use during normal operation.

Exception: Economizers on VAV systems that cause zone level heating to increase due to a reduction in supply air temperature.

23. Revise as follows:

503.4.2 Variable air volume (VAV) fan control. Individual VAV fans with motors of ~~10~~ 7.5 horsepower (~~7.5~~ 5.6 kW) or greater shall be:

1. Driven by a mechanical or electrical variable speed drive;
2. Driven by a vane-axial fan with variable-pitch blades; or
~~2~~3. The fan ~~motor~~ shall have controls or devices that will result in fan motor demand of no more than 30 percent of their design wattage at 50 percent of design airflow when static pressure set point equals one-third of the total design static pressure, based on manufacturer's certified fan data.

Static pressure sensors used to control VAV fans shall be placed in a position such that the controller setpoint is no greater than one-third the total design fan static pressure, except for systems with direct digital control. If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each major branch to ensure the static pressure can be maintained in each branch.

For systems with direct digital control of individual *zone* boxes reporting to the central control panel, the static pressure set point shall be reset based on the *zone* requiring the most pressure, i.e., the set point is reset lower until one *zone* damper is nearly wide open.

24. Revise Section 505.1 as follows:

505.1 General (Mandatory). This section covers lighting system controls, the connection of ballasts, the maximum lighting power for interior applications and minimum acceptable lighting equipment for exterior applications.

Lighting within dwelling units where ~~50~~ 75 percent or more of the permanently installed interior light fixtures are fitted with high-efficacy lamps or a minimum of 75 percent of the permanently installed lighting fixtures shall contain only high efficacy lamps.

Exception: Low-voltage lighting.

25. Revise Section 505.2 as follows:

505.2.1 Interior lighting controls. Each area enclosed by walls or floor-to-ceiling partitions shall have at least one manual control for the lighting serving that area. The required controls shall be located within the area served by the controls or be a remote switch that identifies the lights served and indicates their status.

Exceptions:

1. Areas designated as security or emergency areas that must be continuously lighted.
2. Lighting in stairways or corridors that are elements of the means of egress.

505.2.2 Additional controls. Each area that is required to have a manual control shall have additional controls that meet the requirements of Sections 505.2.2.1 and 505.2.2.2.

505.2.2.1 Light reduction controls. Each area that is required to have a manual control shall also allow the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50 percent. Lighting reduction shall be achieved by one of the following or other *approved* method:
1. Controlling all lamps or luminaires;
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps;
3. Switching the middle lamp luminaires independently of the outer lamps; or
4. Switching each luminaire or each lamp.

Exceptions:

1. Areas that have only one luminaire.
2. Areas that are controlled by an occupant-sensing device.
3. Corridors, storerooms, restrooms or public lobbies.
4. *Sleeping unit* (see Section 505.2.3).
5. Spaces that use less than 0.6 watts per square foot (6.5 W/m2).
6. Daylight spaces complying with Section 505.2.2.2.3 Automatic Daylighting Controls

505.2.2.2 ~~**505.2.2.3**~~ **Daylight Zone Control.** Daylight zones shall be provided with individual controls which control the lights independent of general area lighting. Contiguous daylight zones adjacent to vertical fenestration are allowed to be controlled by a single controlling device provided that they do not include zones facing more than two adjacent cardinal orientations (i.e. north, east, south, west). Daylight zones under skylights more than 15 feet from the perimeter shall be controlled separately from daylight zones adjacent to vertical fenestration.

Exception: Daylight spaces enclosed by walls or ceiling height partitions and containing two or fewer light fixtures are not required to have a separate switch for general area lighting.

~~**505.2.2.2 Automatic lighting shutoff.** Buildings larger than 5,000 square feet (465m2) shall be equipped with an automatic control device to shut off lighting in those areas. This automatic control device shall function on either:~~

~~1. A scheduled basis, using time-of-day, with an independent program schedule that controls the interior lighting in areas that do not exceed 25,000 square feet (2323 m2) and are not more than one floor; or~~
~~2. An occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space; or~~
~~3. A signal from another control or alarm system that indicates the area is unoccupied.~~

~~**Exception:** The following shall not require an automatic control device:~~

~~1. *Sleeping unit* (see Section 505.2.3).~~
~~2. Lighting in spaces where patient care is directly provided.~~
~~3. Spaces where an automatic shutoff would endanger occupant safety or security.~~

~~**505.2.2.2.1 Occupant override.** Where an automatic time switch control device is installed to comply with Section 505.2.2.2, Item 1, it shall incorporate an override switching device that:~~

~~1. Is readily *accessible*.~~
~~2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated.~~
~~3. Is manually operated.~~
~~4. Allows the lighting to remain on for no more than 2 hours when an override is initiated.~~
~~5. Controls an area not exceeding 5,000 square feet (465 m2).~~

~~**Exceptions:**~~

~~1. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, where captive-key override is utilized, override time shall be permitted to exceed 2 hours.~~
~~2. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, the area controlled shall not exceed 20,000 square feet (1860 m2).~~

~~**505.2.2.2.2 Holiday scheduling.** If an automatic time switch control device is installed in accordance with Section 505.2.2.2, Item 1, it shall incorporate an automatic holiday scheduling feature that turns off all loads for at least 24 hours, then resumes the normally scheduled operation.~~

~~**Exception:** Retail stores and associated malls, restaurants, grocery stores, places of religious worship and theaters.~~

~~**505.2.2.3 Daylight zone control.** Daylight zones, as defined by this code, shall be provided with individual controls that control the lights independent of general area lighting. Contiguous daylight zones adjacent to vertical fenestration are allowed to be controlled by a single controlling device provided that they do not include zones facing more than two adjacent cardinal orientations (i.e., north, east, south, west). Daylight zones under skylights more than 15 feet (4572 mm) from the perimeter shall be controlled separately from daylight zones adjacent to vertical fenestration.~~

~~**Exception:** Daylight spaces enclosed by walls or ceiling height partitions and containing two or fewer light fixtures are not required to have a separate switch for general area lighting.~~

505.2.2.3 **Automatic lighting controls.** All commercial buildings shall be equipped with automatic control devices to shut off lighting in compliance with one of the following automatic control technologies:

1. Section 505.2.2.3.1 Occupancy Sensors

2. Section 505.2.2.3.2 Time Clock Controls
3. Section 505.2.2.3.3 Automatic Daylighting Controls

Any lighting control required in Sections 505.2.2.3.1, 505.2.2.2.3.2 and 505.2.2.3.3 shall either be manual on or shall be controlled to automatically turn the lighting on to not more than 50% power unless otherwise provided in Sections 505.2.2.3.1, 505.2.3.2 or 505.2.2.3.3.

Exception: Full automatic-on controls shall be permitted to control lighting in public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.

505.2.2.3.1 Occupancy sensors. Occupancy sensors shall be installed in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms and janitorial closets, and other spaces 300 sf. or less enclosed by ceiling height partitions. These automatic control devices shall be installed to automatically turn off lights within 30 minutes of all occupants leaving the space, except spaces with multi-scene control.

505.2.2.3.2 Time Clock Controls In areas not controlled by occupancy sensors, automatic time switch control devices shall be used. It shall incorporate an override switching device that:

1. Is readily accessible.
2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated.
3. Is manually operated.
4. Allows the lighting to remain on for no more than 2 hours when an override is initiated.
5. Controls an area not exceeding 5,000 square feet (465 m2).

Exceptions:

1. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, where captive-key override is utilized, override time may exceed 2 hours.
2. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, the area controlled may not exceed 20,000 square feet (1860 m2).

505.2.2.3.3 Automatic daylighting controls. Automatic controls installed in daylight zones shall control lights in the daylit areas separately from the non-daylit areas. Controls for calibration adjustments to the lighting control device shall be readily accessible to authorized personnel. Each daylight control zone shall not exceed 2,500 square feet. Automatic daylighting controls must incorporate an automatic shut-off ability based on time or occupancy in addition to lighting power reduction controls.

Controls will automatically reduce lighting power in response to available daylight by either one of the following methods:

1. Continuous dimming using dimming ballasts and daylight-sensing automatic controls that are capable of reducing the power of general lighting in the daylit zone continuously to less than 35% of rated power at maximum light output.
2. Stepped Dimming using multi-level switching and daylight-sensing controls that are capable of reducing lighting power automatically. The system should provide a minimum of two control channels per zone and be installed in a manner such that at least one control step shall reduce power of general lighting in the daylit zone by 30% to 50% of rated power and another control step that reduces lighting power by 65% to 100%. Stepped dimming control is not allowed in continuously occupied areas with ceiling heights of 14 feet or lower.

   Exception: Daylight spaces enclosed by walls or ceiling height partitions and containing 2 or fewer luminaire are not required to have a separate switch for general area lighting.

505.2.3 Specific Application Controls. Specific application controls shall be provided for the following:

1. Display/Accent Lighting—display or accent lighting shall have a separate control device.
2. Case Lighting—lighting in cases used for display purposes shall have a separate control device.
3. Hotel and Motel Guest Room Lighting—hotel and motel guest rooms and guest suites shall have a master control device at the main room entry that controls all permanently installed luminaires and switched receptacles.

4. Task Lighting—supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided the control device is readily accessible and located so that the occupant can see the controlled lighting.
5. Non-visual Lighting—lighting for non-visual applications, such as plant growth and food warming, shall have a separate control device.
6. Demonstration Lighting—lighting equipment that is for sale or for demonstrations in lighting education shall have a separate control device.

Exceptions: Where LED lighting is used no additional control is required for items 1., 2. and 4.

505.2.4 Functional Testing. Controls for automatic lighting systems shall be tested prior to and as a condition for issuance of an approval under Section 104.8. Testing shall ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions. The construction documents shall state the party who will conduct the required functional testing. The party responsible for the functional testing shall not be directly involved in the design or construction of the project and shall provide documentation to the *code official* certifying that the installed lighting controls meet the provisions of Section 505.

When *occupant sensors*, time switches, programmable schedule controls, *photosensors or daylighting controls* are installed, at a minimum, the following procedures shall be performed:

1. Confirm that the placement, sensitivity and time-out adjustments for *occupant sensors* yield acceptable performance, i.e. lights turn off only after space is vacated and do not turn on unless space is occupied.
2. Confirm that the time switches and programmable schedule controls are programmed to turn the lights off.
3. Confirm that photosensor controls reduce electric light based on the amount of usable daylight in the space as specified.

~~505.2.3~~ **505.2.5 Sleeping unit controls.** *(No change to current text)*

~~505.2.4~~ **Exterior lighting controls.** *(No change to current text)*

26. Delete and substitute as follows as follows:

~~**TABLE 505.5.2**~~
~~**INTERIOR LIGHTING POWER ALLOWANCES**~~

~~**Building Area Typea**~~	~~**(W/ft2)**~~
~~Automotive Facility~~	~~0.9~~
~~Convention Center~~	~~1.2~~
~~Court House~~	~~1.2~~
~~Dining: Bar Lounge/Leisure~~	~~1.3~~
~~Dining: Cafeteria/Fast Food~~	~~1.4~~
~~Dining: Family~~	~~1.6~~
~~Dormitory~~	~~1.0~~
~~Exercise Center~~	~~1.0~~
~~Gymnasium~~	~~1.1~~
~~Healthcare—clinic~~	~~1.0~~
~~Hospital~~	~~1.2~~
~~Hotel~~	~~1.0~~
~~Library~~	~~1.3~~
~~Manufacturing Facility~~	~~1.3~~
~~Motel~~	~~1.0~~
~~Motion Picture Theater~~	~~1.2~~

~~Building Area Typea~~	~~(W/ft2)~~
~~Multifamily~~	~~0.7~~
~~Museum~~	~~1.1~~
~~Office~~	~~1.0~~
~~Parking Garage~~	~~0.3~~
~~Penitentiary~~	~~1.0~~
~~Performing Arts Theater~~	~~1.6~~
~~Police/Fire Station~~	~~1.0~~
~~Post Office~~	~~1.1~~
~~Religious Building~~	~~1.3~~
~~Retailb~~	~~1.5~~
~~School/University~~	~~1.2~~
~~Sports Arena~~	~~1.1~~
~~Town Hall~~	~~1.1~~
~~Transportation~~	~~1.0~~
~~Warehouse~~	~~0.8~~
~~Workshop~~	~~1.4~~

TABLE 505.5.2
LIGHTING POWER DENSITY

Building Area Type[a]	**Whole Building**	**Space by Space**
	(W/ft2)	
Active Storage		0.8
Atrium – First Three Floors		0.6
Atrium – Each Additional Floor		0.2
AUTOMOTIVE FACILITY	0.9	
Classroom/lecture/training		1.3
Conference/Meeting/Multipurpose		1.1
Corridor/Transition		0.5
Electrical/Mechanical		1.1
Food Preparation		1.2
Inactive Storage		0.2
Lobby		1.1
Restroom		0.8
Stairway		0.6
CONVENTION CENTER	1.2	
Exhibit Space		1.3
Audience/Seating Area		0.9
COURTHOUSE	1.2	
Audience/Seating Area		0.9
Courtroom		1.9
Confinement Cells		0.9
Judges Chambers		1.3
Dressing/Locker/Fitting Room		0.6
DINING: BAR LOUNGE/LEISURE	1.3	
Lounge/Leisure Dining		1.4
DINING: CAFETERIA/FAST FOOD	1.4	
DINING: FAMILY	1.6	
Dining		1.4
Kitchen		1.2
DORMITORY	1	
Living Quarters		1.1

Building Area Type[a]	Whole Building	Space by Space
Bedroom		0.5
Study Hall		1.4
EXERCISE CENTER	1	
Dressing/Locker/Fitting Room		0.6
Audience/Seating Area		0.3
Exercise Area		0.9
Exercise Area/Gymnasium		0.9
RETAIL: SUPERMARKET	1.3	
GYMNASIUM	1.1	
Dressing/Locker/Fitting Room		0.6
Audience/Seating Area		0.4
Playing Area		1.4
Exercise Area		0.9
HEALTHCARE CLINIC	1	
Corridors w/patient waiting, exam		1
Exam/Treatment		1.5
Emergency		2.7
Public & Staff Lounge		0.8
Hospital/Medical supplies		1.4
Hospital - Nursery		0.6
Nurse station		1
Physical therapy		0.9
Patient Room		0.7
Pharmacy		1.2
Hospital/Radiology		0.4
Operating Room		2.2
Recovery		0.8
Active storage		0.9
Laundry-Washing		0.6
HOTEL	1	
Dining Area		1.3
Guest quarters		1.1
Reception/Waiting		2.5
Lobby		1.1
LIBRARY	1.3	
Library-Audio Visual		0.7
Stacks		1.7
Card File & Cataloguing		1.1
Reading Area		1.2
MANUFACTURING FACILITY	1.3	
MOTEL	1	
Dining Area		1.2
Guest quarters		1.1
Reception/Waiting		2.1
MOTION PICTURE THEATER	1.2	
Audience/Seating Area		1.2
Lobby		1
MULTI-FAMILY	0.7	
MUSEUM	1.1	
Active Storage		0.8
General exhibition		1
Restoration		1.7
OFFICE	0.9	
Enclosed		1
Open Plan		1
PARKING GARAGE	0.3	
PENITENTIARY	1.0	

Building Area Type[a]	Whole Building	Space by Space
PERFORMING ARTS THEATER	1.6	
Audience/Seating Area		2.6
Lobby		3.3
Dressing/Locker/Fitting Room		1.1
POLICE STATIONS	1	
FIRE STATIONS	0.8	
Fire Station Engine Room		0.8
Sleeping Quarters		0.3
Audience/Seating Area		0.8
Police Station Laboratory		1.4
POST OFFICETS/SF	1.1	
Sorting Area		1.2
Lobby		1
RELIGIOUS BUILDINGS	1.3	
Lobby		0.6
Worship/Pulpit/Choir		2.4
RETAIL	1.3	
Department Store Sales Area		1.3
Specialty Store Sales Area		1.8
Fine Merchandise Sales Area		2.9
Supermarket Sales Area		1.3
Personal Services Sales Area		1.3
Mass Merchandising Sales Area		1.3
Mall Concourse		1.7
SCHOOL/UNIVERSITY	1.2	
Classroom		1.3
Audience		0.7
Dining		1.1
Office		1.1
Corridor		0.5
Storage		0.5
Laboratory		1.1
RETAIL: SPECIALTY b	1.6	
TOWN HALL	1.1	
TRANSPORTATION	1	
Dining Area		2.1
Baggage Area		1
Airport - Concourse		0.6
Terminal - Ticket Counter		1.5
Reception/Waiting		0.5
SPORTS ARENA	1.1	
WAREHOUSE	0.6	
Fine Material		1.4
Medium/Bulky Material		0.6
WORKSHOP	1.4	

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m2.

a. ~~In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply~~.

b. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below shall be added to the interior lighting power determined in accordance with this line item.

Calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance = ~~1000watts +~~ (Retail Area 1 X 0~~.6~~ 4W/ft2) + (Retail Area 2 X 0.6 W/ft2) + (Retail Area 3 X ~~1.4~~ 0.9 W/ft2) + (Retail Area 4 X ~~2.5~~ 1.5 W/ft2).

where:

Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4.
Retail Area 2 = The floor area used for the sale of vehicles, sporting goods and small electronics.
Retail Area 3 = The floor area used for the sale of furniture, clothing, cosmetics and artwork.
Retail Area 4 = The floor area used for the sale of jewelry, crystal and china.

Exception: Other merchandise categories are permitted to be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is *approved* by the authority having jurisdiction.

27. Add new text as follows:

SECTION 506
ADDITIONAL EFFICIENCY PACKAGE OPTIONS

506.1 Requirements. Buildings shall comply with at least one of the following:

1. 506.2 Efficient HVAC Performance Requirement
2. 506.3 Efficient Lighting System Requirement
3. 506.4 On-Site Supply of Renewable Energy

At the time of plan submittal, the *code official* shall be provided, by the permittee, documentation designating the intent to comply with Section 506.2, 506.3 or 506.4 in their entirety. Individual tenant spaces must comply with either 506.2 or 506.3 in their entirety unless documentation can be provided that demonstrates compliance with Section 506.4 for the entire building.

506.2 Efficient Mechanical Equipment. Equipment shall meet the minimum efficiency requirements of Tables 506.2.(1) through 506.2(7) in addition to the requirements in Section 503. This section shall only be used where an equipment efficiency option is available.

TABLE 506.2(1)
UNITARY AIR CONDITIONERS AND CONDENSING UNITS, ELECTRICALLY OPERATED, EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	REQUIRED EFFICIENCYa
Air conditioners, Air cooled	< 65,000 Btu/hd	Split system	For zones 1 to 5: 15.0 SEER, 12.5 EER For zones 6 to 8: 14 SEER, 12 EER
		Single package	For zones 1 to 5: 15.0 SEER, 12.0 EER For zones 6 to 8: 14.0 SEER 11.6 EER
	≥ 65,000 Btuh/h and < 240,000 Btu/h	Split system and single package	For zones 1 to 5: 12.0 EERb, 12.4 IPLVb For zones 6 to 8: 11.5 EERb, 11.9 IPLVb
	≥ 240,000 Btu/h and < 760,000 Btu/h	Split system and single package	For zones 1 to 5: 10.8 EERb, 12.0 IPLVb For zones 6 to 8: 10.5 EERb, 10.9 IPLVb
	≥ 760,000 Btu/h		For zones 1 to 5: 10.2 EERb, 11.0 IPLVb For zones 6 to 8: 9.7 EERb, 11.0 IPLVb
Air conditioners, Water and evaporatively cooled		Split system and single package	14.0 EER

For SI: 1 British thermal unit per hour = 0.2931 W.
a. IPLVs are only applicable to equipment with capacity modulation.
b. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

TABLE 506.2(2)
UNITARY AND APPLIED HEAT PUMPS, ELECTRICALLY OPERATED, EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	REQUIRED EFFICIENCYa
Air cooled (Cooling mode)	< 65,000 Btu/hd	Split system	For zones 1 to 5: 15.0 SEER, 12.5 EER For zones 6 to 8: 14.0 SEER, 12.0 EER
		Single package	For zones 1 to 5: 15.0 SEER, 12.0 EER For zones 6 to 8: 14.0 SEER, 11.6 EER
	≥ 65,000 Btu/h and < 240,000 Btu/h	Split system and single package	For zones 1 to 5: 12.0 SEER, 12.4 EER For zones 6 to 8: 11.5 EERb, 11.9 IPLVb
	≥ 240,000 Btu/h	Split system and single package	For zones 1 to 5: 12.0 SEER, 12.4 EER For zones 6 to 8: 10.5 EERb, 10.9 IPLVb
Water SOURCES (Cooling mode)	< 135,000 Btu/h	85°F entering water	14.0 EER
Air cooled (Heating mode)	< 65,000 Btu/hd (Cooling capacity)	Split system	For zones 1 to 5: 9.0 HSPF For zones 6 to 8: 8.5 HSPF
		Single package	For zones 1 to 5: 8.5 HSPF For zones 6 to 8: 8.0 HSPF
	≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.4 COP
		17°F db/15°F wb outdoor air	2.4 COP
	≥ 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.2 COP
		77°F db/15°F wb outdoor air	2.1 COP
Water SOURCES (Heating mode)	< 135,000 Btu/h (Cooling capacity)	70°F entering water	4.6 COP

For SI: °C = [(°F) - 32] / 1.8, 1 British thermal unit per hour = 0.2931 W.
db = dry-bulb temperature, °F; wb = wet-bulb temperature, °F
a. IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.
b. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

TABLE 506.2(3)
PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINALHEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	REQUIRED EFFICIENCYb
Air conditioners	< 7,000 Btu / h	11.9 EER
& Heat Pumps (Cooling Mode)	7,000 Btu / h and < 10,000 Btu / h	11.3 EER
	10,000 Btu / h and < 13,000 Btu / h	10.7 EER
	≥ 13,000 Btu / h	9.5 EER

a. Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) high and less than 42 inches (1067 mm) wide.

TABLE 506.2(4)
WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS, WARM AIR DUCT FURNACES AND UNIT HEATERS, EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	REQUIRED EFFICIENCY	TEST PROCEDURE
Warm air furnaces, gas fired	< 225,000 Btu/h	—	For zones 1 & 2, NR. For zones 3 & 4 90 AFUE or 90 Et For zones 4-8 are 92 AFUE or 92 Et	DOE 10 CFR Part 430 or ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity	90% Ec note 1	ANSI Z21.47
Warm air furnaces, oil fired	< 225,000 Btu/h	—	For zones 1 & 2, NR. For zones 3 to 8 are 85 AFUE or 85 Et	DOE 10 CFR Part 430 or UL 727
	≥ 225,000 Btu/h	Maximum capacity	85% Et, Note 1	UL 727
Warm air duct furnaces, gas fired	All capacities	Maximum capacity	*90% Ec*	ANSI Z83.8
Warm air unit heaters, gas fired	All capacities	Maximum capacity	*90% Ec*	ANSI Z83.8
Warm air unit heaters, oil fired	All capacities	Maximum capacity	*90% Ec*	UL 731

For SI: 1 British thermal unit per hour = 0.2931 W.

1 Units must also include an IID (intermittent ignition device), have jackets not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.
Where there two ratings units not covered by the National Appliance Energy Conservation Act of 1987 (NAECA) (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h [19 kW]) shall comply with either rating.
Et = Thermal efficiency.
Ec = Combustion efficiency (100% less flue losses).
Efficient furnace fan: All fossil fuel furnaces in zones 3 to 8 shall have a furnace electricity ratio not greater than 2% and shall include a manufacturer's designation of the furnace electricity ratio.

TABLE 506.2(5)
BOILER, EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	TEST PROCEEDURE	REQUIRED EFFICIENCY
Gas Hot Water	< 300,000 Btu / h	DOE 10 CFR Part 430	90% Et
	> 300,000 Btu / h and > 2.5 mBtu/h	DOE 10 CFR Part 431	89% Et
Gas Steam	< 300,000 Btu / h	DOE 10 CFR Part 430	89% Et
	> 300,000 Btu / h	DOE 10 CFR Part 431	89% Et
Oil	< 300,000 Btu / h	DOE 10 CFR Part 430	90% Et
	> 300,000 Btu / h	DOE 10 CFR Part 431	89% Et
Et = thermal efficiency			

TABLE 506.2(6)
CHILLERS - EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	REQUIRED EFFICIENCY- CHILLERS		OPTIONAL COMPLIANCE PATH - REQUIRED EFFICIENCY - CHILLERS WITH VSD	
		Full Load (KW /TON)	IPLV (KW /TON)	Full Load (KW /TON)	IPLV (KW /TON)
Air Cooled w/ Condenser	All	1.2	1.0	N/A	N/A
Air Cooled w/o Condenser	All	1.08	1.08	N/A	N/A
Water Cooled, Reciprocating	All	0.840	0.630	N/A	N/A
Water Cooled, Rotary Screw and Scroll	< 90 tons	0.780	0.600	N/A	N/A
	[3]90 tons and < 150 tons	0.730	0.550	N/A	N/A
	[3]150 tons and < 300 tons	0.610	0.510	N/A	N/A
	> 300 tons	0.600	0.490	N/A	N/A
Water Cooled, Centrifugal	< 150 tons	0.610	0.620	0.630	0.400
	[3] 150 tons and < 300 tons	0.590	0.560	0.600	0.400
	300 tons and < 600 tons	0.570	0.510	0.580	0.400
	> 600 tons	0.550	0.510	0.550	0.400

a. Compliance with full load efficiency numbers and IPLV numbers are both required.
b. Only Chillers with Variable Speed Drives (VSD) may use the optional compliance path for chiller efficiency.
N/A – No credit can be taken for this option

TABLE 506.2(7)
ABSORPTION CHILLERS - EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	REQUIRED EFFICIENCY FULL LOAD COP (IPLV)
Air Cooled, Single Effect	0.60, allowed only in heat recovery applications
Water Cooled, Single Effect	0.70, allowed only in heat recovery applications
Double Effect - Direct Fired	1.0 (1.05)
Double Effect - Indirect Fired	1.20

506.3 Efficient Lighting System. Whole Building Lighting Power Density (Watts/sf) shall meet the requirements *of Table 506.3. and automatic daylighting control requirements in Section 506.3.2.*

506.3.1 Reduced Lighting Power Density - The total interior lighting power (watts) is the sum of all interior lighting powers for all areas in the building. The interior lighting power is the floor area for the building times the value from Table 506.3.

TABLE 506.3
REDUCED INTERIOR LIGHTING POWER

BUILDING TYPE[a]	**REDUCED WHOLE BUILDING** (Watts/Ft^2)
AUTOMOTIVE FACILITY	0.79
CONVENTION CENTER	1.16
COURTHOUSE	1.08
DINING: BAR LOUNGE/LEISURE	1.19
DINING: CAFETERIA/FAST FOOD	1.34
DINING:FAMILY	1.50
DORMITORY	0.90
EXERCISE CENTER	0.92
FIRE STATIONS	0.74
GYMNASIUM	1.07
HEALTHCARE CLINIC	0.89
HOTEL	0.90
LIBRARY	1.00
MANUFACTURINBG FACILITY	1.24
MOTEL	0.90
MOTION PICTURE THEATER	1.18
MUSEUM	1.04
OFFICE	0.80
PERFORMING ARTS THEATER	1.46
POLICE STATIONS	0.89
POST OFFICE	0.98
RELIGIOUS BUILDINGS	1.18
RETAIL	1.30
RETAIL: SPECIALTY	1.40
RETAIL: SUPERMARKET	1.30
SCHOOL/UNIVERSITY	1.01
TOWN HALL	0.94
TRANSPORTATION	0.85
WAREHOUSE[b]	0.60
WORKSHOP	1.20

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m2.

a. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply.

b. At least one half of the floor area shall be in the daylight zone. Automatic daylighting controls shall be installed in daylit zones and shall meet the requirements of Section 505.2.2.2.3.

506.3.2 Automatic Daylighting Controls. Automatic daylighting controls shall be installed in all daylight zones and shall meet the requirements of Section 505.2.2.2.

506.4 On-site Supply of Renewable Energy The building or surrounding property shall supply 3% or more of the building energy use associated with systems and equipment covered by this code through on-site renewable energy. On-site power generation using nonrenewable sources does not meet this requirement.

The *code official* shall be provided with an energy analysis as described in Section 507 that documents on-site renewable energy production is capable of providing at least 3% of the total estimated annual purchased energy for the building functions regulated by this code, or a calculation demonstrating that on-site renewable energy production has a nominal (maximum) rating of at least 1.75 BTUs or at least 0.50 watts per square foot of conditioned floor area.

28. Add new standards to Chapter 6 as follows:

ASTM

E779-03	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
E1677-95 (2000)	Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls
E2178-03	Standard Test Method for Air Permeance of Building Materials
E2357-05	Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
C1371-04	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
C1549	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
E408-71 (02)	Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques
E1918-97	Standard Test Method for Measuring Solar Reflectance of Horizontal or Low-Sloped Surfaces in the Field

Reason: *New Buildings Institute (NBI)-American Institute of Architects (AIA)*

NBI and AIA believe that the 20-30% reductions in commercial and high-rise residential building energy use based on this proposal are practical, feasible, and necessary. This Proposal employs improvements to design practices and use of widely available products to improve energy efficiency. Many of the elements have been previously published in NBI's *Core Performance Guide* and implemented in programs or codes at the local and state levels. Incorporating these enhancements in a national model code will help move building practices and markets more quickly, addressing national concerns for energy and the environment in a pragmatic and cost-effective way.

SUBSTANTIATING MATERIAL

The bibliography of substantiating material, along with the technical information and technical substantiation, can be found at www.newbuildings.org/iecc.htm.

THE PROPOSAL

This proposal substantially revises Chapter 5 of the IECC with a series of measures that are integrated to achieve significant energy savings over current national model code. The proposal builds on and updates from 2009 IECC, plus it introduces some new elements such as commissioning of critical systems and a section on "additional efficiency package options" to offer flexibility in achieving these significant savings. Key elements of the Proposal are:

Building Envelope - Includes continuous air barriers, significant improvements in most glazing, and enhancements to opaque envelope performance.

Mechanical Systems – Improves sections regarding economizers, incorporates more use of demand controlled ventilation, and provides additional calculation procedures for determining loads and equipment sizing.

Quality Assurance – Incorporates requirements for testing and commissioning of mechanical systems and performance testing of daylight-related controls.

Lighting - Reduces energy needed for lighting based on more efficient illuminating equipment and the use of several lighting control strategies.

Daylighting – Includes additional availability of toplight sources when combined with automatic daylight controls, and comprehensive control strategy for all daylit zones.

Advanced Efficiency Package Options - Section 506 contains three approximately energy-equivalent packages to add to the savings in this Proposal: These three options are focused on Efficient HVAC Equipment, Reduced Lighting Power Density plus Automatic Daylight Controls, or Onsite Renewable Energy Generation. These options round out the savings in the Proposal and also offer important flexibility in getting to higher levels of efficiency. As energy codes move to higher efficiency levels with new types of strategies, building flexibility into prescriptive codes will offer additional pathways to support market adoption and compliance.

Cost Impact: None given.

WE ARE APARTMENTS

The country needs to build 4.3 million more apartments by 2035.

NATIONAL DATA

Apartments and their residents contribute $3.4 trillion to the U.S. economy annually, supporting 17.5 million jobs.

The number of affordable units (those with rents less than $1,000 per month) declined by 4.7 million from 2015 to 2020.

Our Resources

The apartment industry stands ready to work with urban, suburban and rural communities in every region to meet the housing demand of Americans across all income levels.

Our Resources

Hoyt Advisory Services; NMHC / NAA; 2021 American Community Survey, U.S. Census Bureau

MAY 16, 2022

President Biden Announces New Actions to Ease the Burden of Housing Costs

FACT SHEET | BRIEFING ROOM | STATEMENTS AND RELEASES

New Biden-Harris Administration Housing Supply Action Plan to Help Close the Housing Supply Gap in the U.S.

As President Biden said last week, tackling inflation is his top economic priority. Lowering the cost of housing is a critical piece of that effort. It takes on the burden of housing costs by increasing the supply of quality housing in every community. His plan includes legislative and administrative actions to ease the burden of housing costs for families, including by cutting with the certain prescription drug bill of thousands of affordable housing units in the next four years. Prime digital with other administration actions, the plan will lower housing costs for renters and homeowners. Crucially, it brings the gap of 3.8 million affordable rental and owner-attainable homeownership the Americans to move into a home they can afford, in a community they want to live in, and to be thriving equally shielded in America.

The Plan will help renters who are struggling with high rental costs, with a focus on those who are at risk of homelessness or living in low-quality apartments. Increasing the Plan particular to lower supply and an important element of bringing homeownership within reach the Americans. Today, the median price of a home is nearly $400,000 and the median price of a home sold last year increased by nearly 20 percent. Increasing the supply of homes, or housing units made up about one third of all the market-leader for inflation, is essential to the Administration Press Release.

Under the Plan, the Administration will:

- **Increase production that will lower rental housing and lead our policies with higher income or remain housing** and grant provisions, the first time we have ever done so.
- **Double or shorten the time to construct a federal process** even housing where planning gap currently under consideration of housing building permits, and **cut the time to construct a federal process** in half, and **cut the time to construct a federal process** in half, and prefabricated buildings.
- **Expand and improve existing, lower-cost federal financing**, including for affordable multifamily development and preservation. This includes increasing the supply of low-income housing tax credits (LIHTC) and commitment that is also a long-term mortgage-secure credit, established by exploring the feasibility of lower-fee purchase of these loans, promoting the use of LIHTC and other federal housing finance programs, including expand affordable housing development and construction jobs in the Section Housing Tax Credit (LIHTC), which provides credits to private developers of affordable housing in exchange for a set-aside of units for low-income tenants, and the Department of Treasury's Community Development Financial Institutions Fund (CDFI Fund).
- **Ensure that more government-owned supply of homes and other housing** **space** is used for affordable housing — or, even better, for sale and rent-to-own — not large institutional investors.

Work with the private sector to address supply chain challenges and improve housing technology to **provide construction in 30 days or the most** **cost-efficient** for the year 2030.

Today's strong housing sector sets the stage for the building. Direct and lower-income housing supply, including the Biden-Harris Administration's Plan to Close the Gap — continuing housing supply, including the lower-cost rental housing and homeownership. This year's investment housing supply and homeownership

National Association of Home Builders

NATIONAL MULTIFAMILY HOUSING COUNCIL

Regulation: 40.6 Percent of the Cost of Multifamily Development

Paul Emrath, National Association of Home Builders (NAHB)
Caitlin Sugrue Walter, National Multifamily Housing Council (NMHC)

Regulation imposed by all levels of government accounts for an average of 40.6 percent of multifamily development costs, according to research by NAHB and NMHC.

Apartment development can be subject to a significant array of regulatory costs, including a broad range of fees, standards and other requirements imposed at different stages of the development and construction process. This joint research effort surveyed NAHB and NMHC members to quantify how much regulation exists and how much it is adding to the cost of developing much-needed new multifamily properties.

About NAHB

The National Association of Home Builders (NAHB) strives to protect the American Dream of housing opportunities for all, while working to achieve professional success for its members who build communities, create jobs and strengthen our economy. NAHB Multifamily provides services, benefits and opportunities to members with an interest in multifamily housing, including multifamily member meetings, newsletters, events, webinars and multifamily housing awards. It coordinates with other NAHB departments on advocacy efforts, economic studies and resources for multifamily housing. For more information, please visit NAHB Multifamily at nahb.org/nahb-community/councils/multifamily-council.

About NMHC

Based in Washington, D.C., the National Multifamily Housing Council (NMHC) is the leadership of the apartment industry. We bring together the prominent owners, managers and developers who help create thriving communities by providing apartment homes for 40 million Americans, contributing $3.4 trillion annually to the economy. NMHC provides a forum for insight, advocacy and action that enables both members and the communities they help build to thrive. For more information, contact NMHC at 202/974-2300, e-mail the Council at info@nmhc.org, or visit NMHC's website at nmhc.org.

Introduction

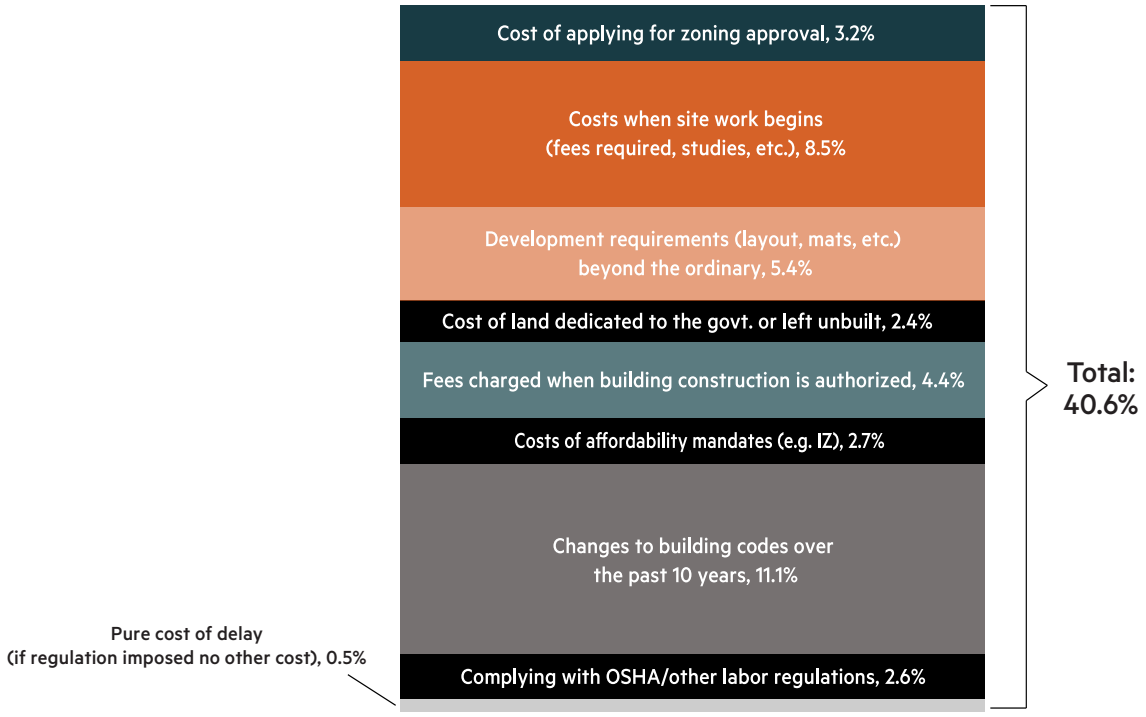
Multifamily development is subject to a variety of regulations at all levels of government. While some of these regulations are necessary to protect the health and safety of residents as well as the integrity of the building or community, it is informative to know the financial impact of each type of regulation, particularly in an era of widespread cost increases and worsening affordability problems for renters. Each added cost means the developer must increase rents for the project to remain financially feasible.

Regulations cover a wide-range of issues, and while they may be well-intentioned, the costs and burdens of any regulation must be carefully weighed against the benefits. Few would argue, for example, that basic safety standards for structures and workers are unnecessary. But, when regulation constitutes an average of 40.6 percent of a project's development costs, this raises questions about how thoroughly governments are considering the consequences of their actions. Are they aware of how much regulation currently exists? Do they realize how multiple regulations with conflicting standards can cause delays and increase costs? And do they understand the extent to which these increased costs translate into higher rents and make it difficult to build new housing that families with modest incomes can afford?

Recently, the National Association of Home Builders (NAHB) and the National Multifamily Housing Council (NMHC) undertook a joint research effort to find out how much government regulation adds to the cost of building new multifamily housing via a survey distributed to multifamily developers. (See Appendix 2).

The research finds that an average of **40.6 percent of total development costs** can now be attributed to complying with regulations imposed by all levels of government. Figure 1 shows how this percentage breaks down among the various types of regulation.

Figure 1. Average Cost of Regulation as a Percent of Total Multifamily Development Cost



Source: NAHB and NMHC

Perhaps more importantly, some of these regulatory mandates can discourage developers from building in the very marketplaces that have the greatest need for more housing. This can prove to be particularly burdensome in a world of rising costs. For example, 47.9 percent of multifamily developers said they avoid building in jurisdictions with policies such as inclusionary zoning, and a full 87.5 percent will avoid building in a jurisdiction with rent control in place.

There are also significant obstacles to development at the community level that are unrelated to governmental regulation. For instance, our research shows that "Not in My Backyard" (NIMBY) opposition to multifamily development adds an average of **5.6 percent to total development costs** and delays the delivery of new housing by an average of **7.4 months**. While most Americans agree that we need more housing and more housing affordable to middle-income households, too many change their opinion when someone proposes to put that new housing in their neighborhood. The intensity of opposition is escalated if that housing is rental housing.

About the Research

NAHB and NMHC distributed an identical survey in April 2022 to their respective memberships to access a wide range of development scales across the United States. The primary purpose was to quantify how much regulation exists for developers to contend with and how much that regulation is adding to the cost of developing new multifamily properties.

Some of these questions quantify the impact of regulations, such as inclusionary zoning and rent control, that not only may directly increase the costs of projects that are built but affect the supply and cost of housing in the community by causing some projects not to be built at all. An additional set of questions asked about the financial impact of NIMBYism, an issue that has been widely identified as one of the major cost drivers impacting affordability but where little quantifiable data currently exists.

A total of 49 usable responses were received. The responses from the survey were combined with existing public data and other survey collections to calculate the financial cost as a percent of total development cost for each regulation. A detailed description of the assumptions used in the calculations can be found in Appendix 1.

Total Cost of Regulations

Regulatory costs that exist during the multifamily development process can be divided into several categories. Table 1 shows the share of developer respondents subject to these various regulations and the average cost of each category as a percentage of the total development cost.

Table 1. Average Regulatory Costs as a Share of Total Multifamily Development

	Share With the Regulatory Cost	Regulation as a Percent of Total Development Cost	
		Average When Present*	Average Across All Properties
Cost of applying for zoning approval	93.9%	3.4%	3.2%
Costs when site work begins (fees, required studies, etc.)	98.0%	8.7%	8.5%
Dev. requirements (layout, mats, etc.) beyond the ordinary	91.8%	5.8%	5.4%
Cost of land dedicated to the goverment or left unbuilt	51.0%	4.7%	2.4%
Fees charged when building construction is authorized	95.9%	4.6%	4.4%
Costs of affordability mandates (e.g., inclusionary zoning)	38.8%	6.9%	2.7%
Changes to building codes over the past 10 years	100.0%	11.1%	11.1%
Complying with OSHA/other labor regulations	93.9%	2.7%	2.6%
Pure cost of delay (if regulation imposed no other cost)	95.9%	0.5%	0.5%
TOTAL COST OF REGULATION	**100.0%**	**40.6%**	**40.6%**

* The base is different for every percentage in this column, so the line items are not additive.

Source: NAHB and NMHC

Understanding Table 1

The last column of the table shows the averages across all multifamily developments in the survey, even those not subject to a particular type of regulation (i.e., the "zeroes" are averaged in). The column to the left of that shows average costs calculated ***only*** for those properties that ***are*** subject to the regulation.

Note that because each percentage in the "Average When Present" column is calculated for a different set of properties, the rows in that column do not add up to the total. The primary reason for including this column is so readers interested in the comparatively uncommon regulations—such as requiring developers to leave some of their land unbuilt and affordability mandates such as inclusionary zoning—can see how costly these regulations tend to be when they are present.

The other categories of regulation in the table are widespread (impacting over 90 percent of multifamily developers). For them, the differences between the "Average When Present" and "Average Across All Properties" columns are negligible.

As Table 1 indicates, the highest average regulatory cost is the result of changes to building codes over the past 10 years (11.1 percent of total development costs). The second highest are the costs imposed when site work begins (8.7 percent). The lowest average cost impact was the pure financial cost of delay, consisting of 0.5 percent when present, lower than the average cost of complying with Occupational Safety and Health Administration (OSHA) or other labor regulations (2.7 percent when present).

The first significant interaction between a multifamily developer and the government typically occurs when the developer applies for zoning approval to allow multifamily housing to be built on a particular parcel of land. Regulatory costs at this stage can vary from costs associated with fees owed to the local jurisdiction for proceeding through the approval process to market or environmental impact studies that must be commissioned from private consultants.

In some cases, a developer can acquire land that allows for multifamily structures to be built on it without requiring rezoning or a special exemption. However, this is rare, with 93.9 percent of the respondents indicating that they must dedicate resources to rezone the land to allow multifamily construction. When they exist, these costs average 3.4 percent of the total development cost.

Once site work begins, local jurisdictions often require a variety of fees or other studies. Examples of fees could include impact fees (fees charged only on a new development to be used for capital improvements) or utility impact fees. Almost all respondents (98.0 percent) reported paying some of these costs in their typical project, representing an average of 8.7 percent of total development costs when present.

Most respondents (91.8 percent) were also required by their local jurisdiction to include certain design features in their project design that go beyond what they would ordinarily include. Examples include energy-efficiency upgrades or specific design requirements for facades. When present, complying with these requirements amounted to an average of 5.8 percent of total development costs.

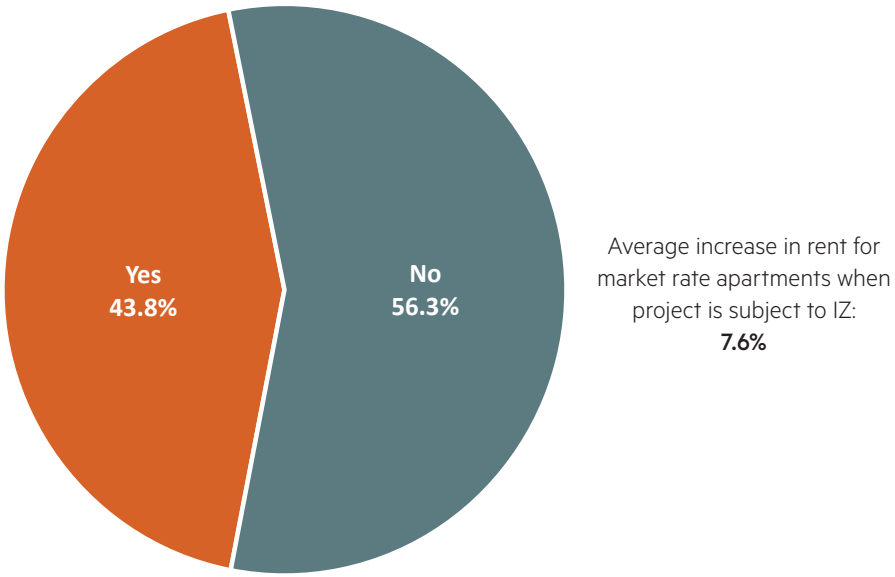
Governments can also require developers to leave a portion of the development site dedicated for government use or left unbuilt. This requirement reduces the amount of developable area, which means the revenue from that area is lost and must either be absorbed or made up for elsewhere. This requirement was present for approximately half (51.0 percent) of respondents; when present, it represented an average of 4.7 percent of total development costs.

Jurisdictions also often charge fees when site work is completed to authorize building construction. Examples of these costs include a fee when filing for a building permit or fees for additional utility hook-ups. Almost all respondents (95.9 percent) reported paying some sort of fee at this phase of development, with an average cost of 4.6 percent of total development cost when present.

Local affordability mandates are another important cost driver. These mandates are designed to increase the supply of affordable apartments. A common example is inclusionary zoning, where developers must offer a certain percentage of apartments at below-market rent levels. In many cases, a density bonus is provided to developers, which allows them to include more units in their project than ordinarily permitted by zoning to offset those lowered rents.

Unfortunately, these incentives are often inadequate and do not fully cover the lost rental revenue. In those cases, developers are forced to raise rents on the unrestricted apartments to fill the gap or to abandon the project altogether because it is no longer financially feasible.[1] These mandates were present in slightly over one-third (38.8 percent) of respondents' typical projects, and when present, they made up an average of 6.9 percent of total development costs (Figure 2). Respondents subject to inclusionary zoning report having to raise rents by an average of 7.6 percent.

Figure 2. Is Respondent's Typical Project in a Jurisdiction with Inclusionary Zoning? (Percent of Respondents)



Source: NAHB and NMHC

[1] NAHB has developed an Inclusionary Zoning Calculator Tool to help developers and local jurisdictions determine if incentives are adequate to allow a project to be built.

The increase in costs to comply with changes to building codes over the past 10 years was the largest driver of development cost, amounting to 11.1 percent of total development costs.

Most jurisdictions have been adopting, revising and enforcing building codes for decades, and an entire industry has emerged supporting and encouraging changes to existing building codes. While building codes play an important role in protecting resident safety and building integrity, they have evolved well beyond their original purpose and now are also used to promote public policies like energy efficiency and sustainability.

Building code development and adoption are complex, and it is essential to consider impacts to housing affordability throughout the process. State and local jurisdictions adopt and enforce building codes, but federal policymakers are also active in the development of international model codes, and they promote the adoption of certain code editions. For example, the U.S. Department of Energy encourages states to adopt the most stringent versions of the model energy codes. Various policy groups, industry organizations and individual companies also advocate for code changes that promote specific goals. These changes do not always balance the needs of housing affordability and have the potential to drive up construction costs[2] without improving building safety or integrity.

Developers are also subject to complying with Occupational Safety and Health Administration (OSHA) requirements and other labor regulations throughout the development process. While measures to protect the safety and health of construction workers are essential, NAHB has argued that some OSHA policies, like applying its beryllium standards to residential construction, simply drive construction costs up without impacting health or safety.

Fully 93.9 percent of respondents said they had to comply with these regulations and that they added 2.7 percent to total development costs.

Almost all respondents (95.9 percent) also reported that complying with regulations caused some sort of delay for their typical project. We estimate that "pure" cost of delay—the financial cost that taking the time to comply with that regulation would incur—would be an average of 0.5 percent of total development costs. This may not seem like a substantial number, but in an era of rising costs and diminishing affordability, any additional cost can impact project feasibility.

Affordability Mandates and Neighborhood Opposition Can Discourage Development Altogether

Aside from increasing development costs, some regulations and restrictions can impact whether development even occurs, which is incredibly harmful given the nation's shortage of housing.

There are many factors a developer considers when choosing a potential site for a future development; primary among them is the market demand for the proposed units. Increasingly, however, developers are also forced to consider whether their chosen jurisdiction imposes affordability mandates on new development. Two of the most popular mandates are inclusionary zoning and rent control because they are wrongly deemed to be "quick and free" fixes to housing affordability challenges.

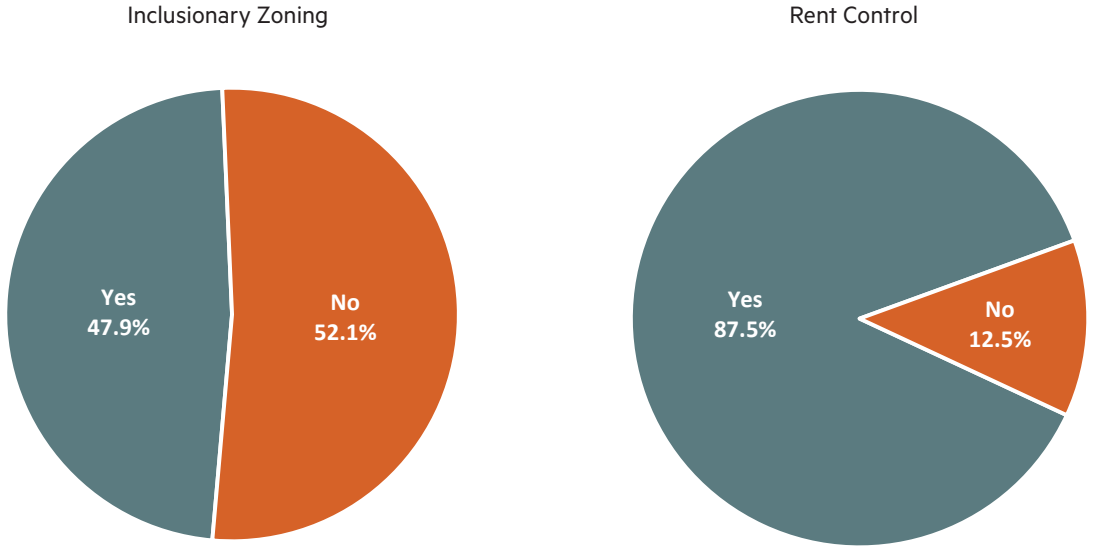
[2] NAHB's subsidiary Home Innovation Research Labs has recently produced a report showing that codes adopted in 2018 increase construction costs for standard types of multifamily buildings between $2,500 and $25,000.

Research has shown, however, that these quick fixes, particularly rent control, have many pitfalls. One major pitfall of both, as shown in Figure 3, is that it can deter development completely. Almost half of the respondents (47.9 percent) reported that they avoid building in jurisdictions with inclusionary zoning policies. The response was more acute for rent control—the overwhelming majority of respondents (87.5 percent) reported they avoid building in jurisdictions where rent control is present.

In fact, these mandates can impact the financial feasibility of a project, both in the short-term and long term. As a result, developers may simply choose to avoid jurisdictions with these mandates because of the difficulty in making a project pencil out.

Rent control regulations similarly differ depending on the local jurisdiction. In its basic form, rent control is a restriction on how much a property owner can raise a resident's rent, ignoring market conditions. Some rent control laws exempt new construction from price controls, and others institute a cap on how much an owner can raise a resident's rent, often tied to the Consumer Price Index (CPI).

Figure 3. Do Multifamily Developers Avoid Building in Jurisdictions with Certain Policies? (Percent Of Respondents)

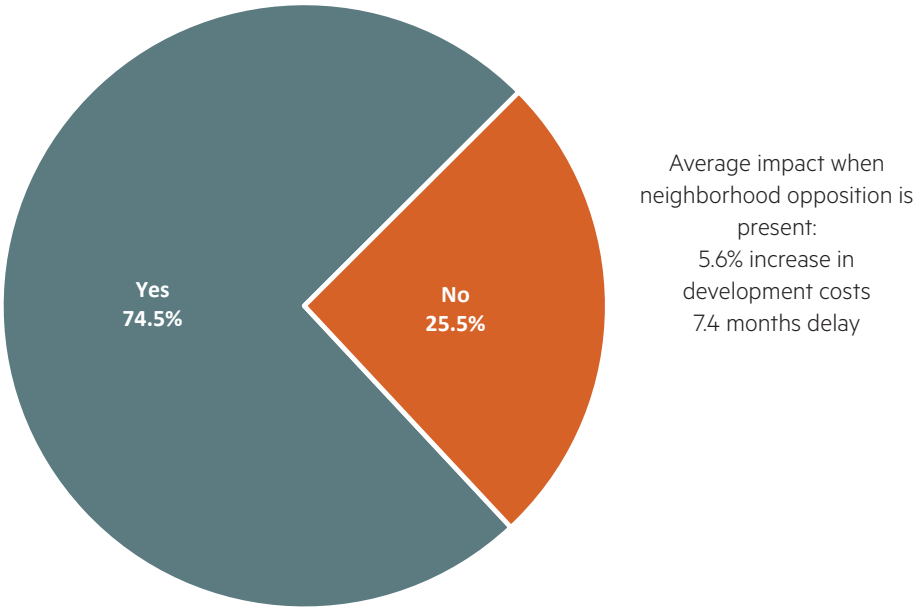


Source: NAHB and NMHC

Another major impediment to whether a project gets built can be neighborhood opposition. Opposition against multifamily development by current residents, commonly referred to as "Not in My Backyard" (NIMBY) opposition, can take many different forms. Residents may fight against rezoning attempts or may even file lawsuits to attempt to prevent development from occurring. Approximately three-quarters (74.5 percent) of respondents reported encountering neighborhood opposition to multifamily construction (Figure 4). The resources required to overcome this opposition add an average 5.6 percent increase in development costs when present. They also delay the development timeline by an

average of 7.4 months.

Figure 4. Have Developers Encountered Neighborhood Opposition To Multifamily Construction? (Percent Of Respondents)



Source: NAHB and NMHC

Conclusion

As the above discussion has demonstrated, multifamily development can be subject to many regulatory costs, including a broad range of fees, standards and other requirements imposed at different stages of the development and construction process. Because of this, it may not be surprising that regulation imposed by all levels of government accounts for 40.6 percent of multifamily development costs on average.

This research was solely restricted to the impact of regulations on total development costs. It is important to note that developers are also dealing with rapidly rising land, material, and labor costs. Combined, these costs make it virtually impossible for private sector developers to deliver housing at a price point that many working Americans can afford.

When multifamily development costs rise, it unavoidably translates to higher rents and reduced rental housing affordability. Multifamily developers cannot secure financing to build their projects unless they can demonstrate to lenders that the rents will be sufficient to cover costs and pay off the loans.

The purpose of this report is not to argue that all regulation is bad and should be eliminated, but that some of these regulations are likely duplicative as multiple levels of government impose regulations on the same project. In addition, many of these regulations do not have a relationship to resident safety or building integrity.

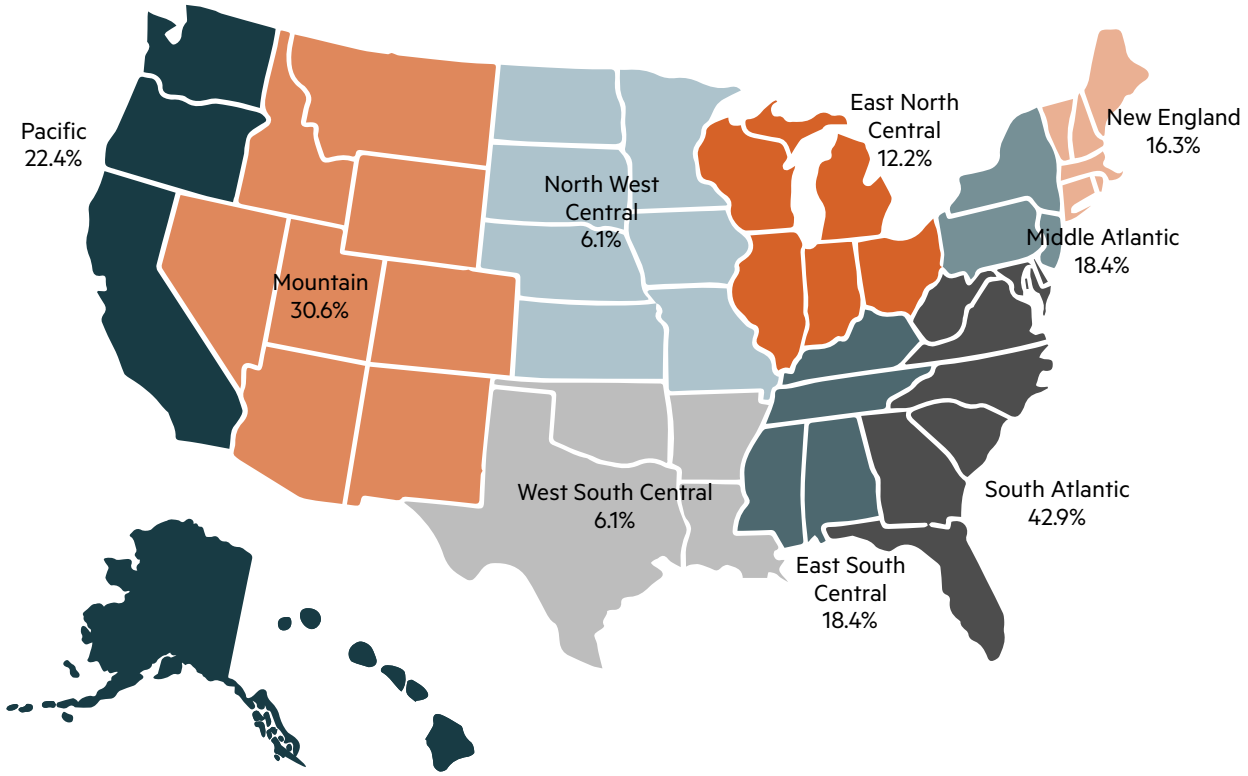
The research aims to raise awareness of how much regulation currently exists, how much it costs and to encourage governments to do a thorough job of considering the implications for housing affordability when proposing and implementing new directives. It is also to help inform local leaders that they also have the power to waive some of these duplicative costs, thus lowering the rent required for the project to remain financially feasible and improving affordability.

Respondent Profile

A total of 49 usable responses were received from multifamily developers, with a slightly higher concentration of NAHB members than NMHC members (and no duplicates). In one instance, two survey responses were accepted from one member company because the respondents represented different geographic areas.

All geographic areas in the United States were represented (see Figure 5). Respondents were able to choose more than one region of operation. The South Atlantic region (DE, DC, FL, GA, MD, NC, SC, VA, WV) had the largest representation, with 42.9 percent of respondents operating there, followed by the Mountain region (AZ, CO, ID, NM, MT, UT, NV, WY) with 30.6 percent and the Pacific region (AK, CA, HI, OR, WA) with 22.4 percent. The West North Central (IA, KS, MN, MO, NE, ND, SD) and West South Central (AR, LA, OK, TX) had the lowest representation at 6.1 percent of respondents each.

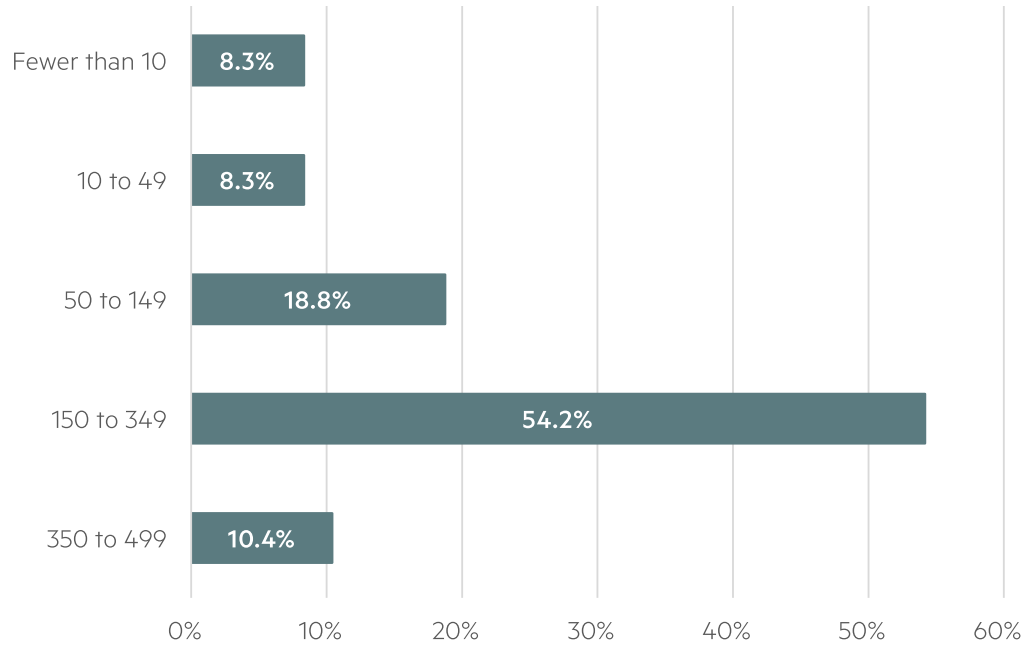
Figure 5. Share of Respondents Who Build in Each of the Nine Census Divisions



Source: NAHB and NMHC; U.S. Census Bureau

The respondents' typical project size varied widely: from fewer than 10 units to 499 (see Figure 6). The majority of respondents (54.2 percent) reported a typical project size of 150 to 349 units. Note that this is project size, not building size, meaning that each category could comprise both garden-style communities, which frequently have units spread across multiple buildings, as well as high-rise buildings, where all units are traditionally in one building.

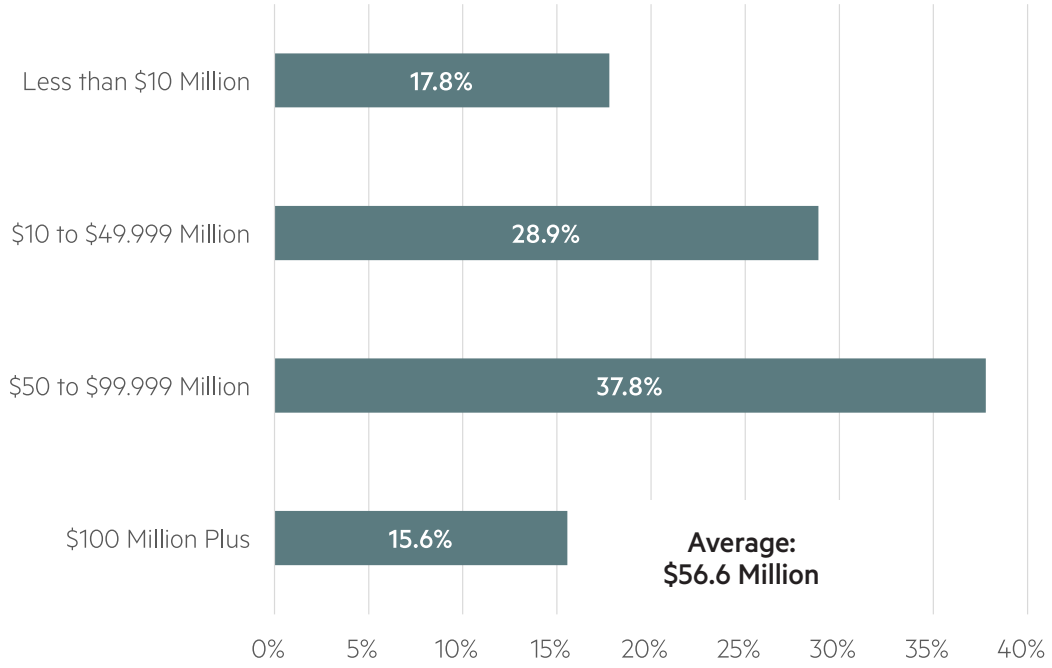
Figure 6. Number of Apartments in Respondent's Typical Project (Percent of Respondents)



Source: NAHB and NMHC

The typical total development cost varied as well but was slightly more evenly distributed (Figure 7). The average total development cost of respondents for a typical project was $53.6 million. Barely over one-third (37.6 percent) reported a typical development cost of $50 to $99.99 million. Small and large projects were equally represented, with 17.8 percent of respondents reporting a cost of less than $10 million and 15.6 percent indicating the typical project costs at least $100 million.

Figure 7. Total Development Costs for Respondent's Typical Project (Percent of Respondents)



Source: NAHB and NMHC

Appendix 1: Assumptions Used in the Calculations

To calculate a final effect on development costs, many of the NAHB-NMHC survey responses need to be combined with additional information. Primarily these are assumptions about the terms of development and construction loans, how long construction typically takes, and how to allocate costs to different stages of the development and construction process. This appendix lists all the assumptions used in the calculations and gives the sources for each.

Loan Terms

1. 1 point charged for all land acquisition, development, and construction (AD&C) loans, based on results from a Quarterly Finance Survey (QFS) that NAHB was conducting in the early to mid-2000s.

A 7.65 percent interest rate on all AD&C loans. The QFS indicates that rates are typically set one point above prime, and 6.65 percent is NAHB's estimate of the prime rate that would prevail in the long run under neutral Federal Reserve policy.

The estimates also assume that three-fourths of any category of costs are financed, based on typical AD&C loan-to-value ratios in the QFS.

Construction Lags

The source for information lags not directly collected in the NAHB-NMHC questionnaire is the Survey of Construction, conducted by the Census Bureau and partially funded by the Department of Housing and Urban Development.

Preliminary estimates are taken from the published annual tables, averaged over the 2001-2016 period:
Authorization to start = 1.71 months
Start to completion = 10.87 months

If the project is 5-9 units
- Authorization to start = 1.95 months
- Start to completion = 11.64 months

If the project is 10+ units
- Authorization to start = 1.94 months
- Start to completion = 13.21 months

The NAHB-NMHC survey collected data on how much time regulation adds to the development process. To assign this to a particular phase of the development, the following assumptions are used.

The regulatory delay is split and attributed half to the lag between applying for zoning approval and the beginning of site work and half to the period after site work begins. If half of the regulatory delay exceeds the lag between applying for approval and the beginning of site work, the excess is also attributed to the period after site work begins.

It is first assumed that the resulting regulatory delay is attributable to the period between the start of site work and the start of building construction, minus three months (the assumed minimum time it would take to do site work in the absence

of regulation, based on conversations with developers). If any regulatory delay remains after being allocated to the zoning approval and site work periods, it is then attributed to the building construction period, and the start-to-completion lag is adjusted upward beyond the SOC-based average, accordingly.

The analysis assumes all loans are paid off when the buildings are completed.

Cost Breakdown

To implement the process described in the paragraph above and calculate a "pure" cost of delay (i.e., the effect regulatory delay would have even if the regulation imposed no other cost), estimates of costs incurred during different phases of the development process are needed.

The breakdown is based on the split between lot and construction costs in NAHB's Construction Cost Surveys (averaged over surveys conducted since 2000) and the Census Bureau's "non-construction cost factor" for raw land. The calculations also assume three-fourths of these costs are financed, based on typical AD&C loan-to-value rations in the QFS.

Resulting assumptions:

- Only the cost of applying for zoning occurs at the very start of the development process. Financing costs associated with this are charged to the regulatory cost of the application and not counted in the pure cost of delay.
- 10.2 percent of total development represents costs financed by a land acquisition loan at the start of the site work phase.
- 10.8 percent of total development costs represent costs financed by a development loan during the site work phase, assuming draws on the loan occur on average halfway through this phase.
- 54.0 percent of total development costs represent costs incurred after building construction has started and financed with a construction loan, again assuming draws on the loan occur on average halfway through the site work phase.

Appendix 2: Survey Questionnaire

1. **What regions do you build in? Please select all that apply.**
   - New England (CT, ME, MA, NH, RI, VT)
   - Mid Atlantic (NJ, NY, PA)
   - South Atlantic (DE, DC, FL, GA, MD, NC, SC, VA, WV)
   - East North Central (IN, IL, MI, OH, WI)
   - West North Central (IA, KS, MN, MO, NE, ND, SD)
   - East South Central (AL, KY, MS, TN)
   - West South Central (AR, LA, OK, TX)
   - Mountain (AZ, CO, ID, NM, MT, UT, NV, WY)
   - Pacific (AK, CA, HI, OR, WA)

2. **How many units does your typical multifamily project have?**
   - 2-4 Units
   - 5-9
   - 10-49
   - 50-149
   - 150-349
   - 350-499
   - 500 units or more

3. **What is the total dollar amount spent on development costs in your typical project?**

   $_____

4. **For a typical piece of land, how much does it cost to apply for zoning approval as a % of total development cost?** *(Include costs of fiscal or traffic impact or other studies and any review or other fees that must be paid by the time of application. Please enter "0" if application costs are Zero percent).*

   _____%

5. **For a typical project, how many months does it take between the time you apply for zoning approval and the time you begin site work?**

   _____months

6. **How much does it cost to comply with regulations when site work begins, as a % of total development costs?** *(Include costs of complying with environmental or other regulations as well as the cost of hook-up or impact or other fees.) Please enter "0" if cost of complying with these regulations is Zero percent.*

   _____%

7. **How much do development requirements that go beyond what you would otherwise do (in terms of property layout, landscaping, materials used on building facades, etc.) add to your cost as a % of total development costs?** *(Please enter "0" if the jurisdiction's requirements don't go beyond what you would normally do.)*

   _____%

8. **In the typical case, what is the value of any land that must be dedicated to the local government or otherwise left unbuilt (for parks, open green space, etc.) as a % of total development cost?** *(Please enter ")" if dedicating land is required infrequently.)*

   _____%

9. **How many months does it take between the time you begin site work and the time you obtain authorization to begin construction of the apartment building(s)?**

   _____months

10. **How much extra time (in months) overall does complying with regulations add to the development process?** *(Please enter "0" if regulations typically cause no delay).*

    _____months

11. **When you obtain authorization to begin construction, how much do you pay in additional fees as a % of total development costs? In many cases, this will be only a permit fee but include any additional impact or hook-up or inspection fees if they kick in at this time.** *(Please enter "0" if fees paid during or after construction are Zero percent).*

    _____%

12a. In the typical case, does a jurisdiction have inclusionary zoning/affordable housing requirements that apply to your project?

- o Yes
- o No

12b. *[If the answer to 12a is "yes"].* **In the typical case, how much do these requirements (or a fee in lieu of affordable housing) cost as a % of total development cost?** *(Please enter "0" if inclusionary zoning/affordable housing mandates/fees in lieu of affordable housing are encountered infrequently).*

_____%

12c. *[If the answer to 12a is "yes"].* **In the typical case, how much do these additional requirements raise the rents of market-rate units?**

_____%

13. **Do you typically avoid building in a jurisdiction if it has an inclusionary zoning requirement?**
    - o Yes
    - o No

14. **Do you typically avoid building in a jurisdiction that has rent control?**
    - o Yes
    - o No

15. **Over the past 10 years, how much have changes in construction codes and standards added to the cost of building a typical multifamily project as a % of total development costs?** *(Please enter "0" if code changes have had minimal impact on costs).*

    _____%

    - Please select if you have not been in operation for the past 10 years

16. **How much does complying with OSHA or other labor regulations cost, as a % of total development cost?** *(Please enter "0" if labor regulations have no impact on development costs).*

    _____%

17. **Have you experienced added costs or delays due to neighborhood opposition to multifamily construction?**
    - Yes
    - No

18. **In the typical case, how much costs are added to a project due to neighborhood opposition to multifamily development as a % of total development costs?**

    _____%

19. **In a typical case, how much extra time (in months) does it take to address neighborhood opposition to multifamily development?**

    _____months

20. **Comments:**

International Code Council
Central Regional Office
4051 Flossmoor Road
Country Club Hills, IL 60478
t: 888.ICC.SAFE (422.7233)
f: 708.799.4981
www.iccsafe.org

ICC MEMORANDUM

TO: Energy Code Development Committees, Subcommittees and Interested Parties
FROM: Mike Pfeiffer, PE, Senior Vice President of Technical Services
RE: Discount Rates and Code Content
DATE: February 15, 2022

The Code Council appreciates the considerable effort to date by members of the Commercial and Residential Consensus Committees, Subcommittees and interested parties to develop the 2024 International Energy Conservation Code and Chapter 11 of the International Residential Code under a standards development process. We are aware of two issues before the committees which if not resolved expeditiously may lead to an inability to complete the Committees' work in a timely manner. This memorandum provides direction to the committees on the use of discount rates in cost effective analysis and the placement of code content in the IECC and IRC, as applicable.

Discount Rates:

In the framework and subsequent committee procedures issued by the Code Council Board of Directors, the procedures for use of cost effectiveness analysis are provided. Per these procedures, "underlying assumptions should be clearly documented including compliance with any parameters set by the committees and approved by the Board." Groups tasked by the committees to develop parameters have successfully reached consensus on many of the items. However, agreement on the discount rate(s) to be used has not been reached to date.

The direction below points to discount rates set by the U.S. Office of Management and Budget (OMB) for use in analysis conducted by federal agencies (including the U.S. Department of Energy). These rates are currently used to support the statutory review DOE conducts upon release of a new edition of the IECC. Cost effectiveness analysis is an important tool for use by the committee in determining the resolution of a proposal. It is up to individual committee members and the Consensus Committees to determine the weight they place on results of a cost effectiveness analysis as it relates to the action taken on the proposals for which cost effectiveness is a consideration.

The Code Council provides the following direction:

> *Consistent with guidance from the U.S. Office of Management and Budget (Circular A-4) the Committees shall conduct cost effectiveness analysis using discount rates of both 3 percent and 7 percent for evaluation of the public input proposals currently under consideration. If OMB revises these rates prior to the posting of Public Comment Draft 1 for comment, the updated discount rates will be used for those comments.*

Code Content:

In the new framework approved by the Board in March 2021, a new scope and intent were developed for the IECC and Chapter 11 of the IRC. While this new scope and intent is considerably more detailed than the prior scope and intent, there is some confusion within the Committees on what topics can be addressed within the body of the IECC or IRC Chapter 11 as minimum requirements as opposed to an IECC or IRC appendix.

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The scope and intent of ICC codes and standards are set by the Board of Directors in accordance with Council Policy 28. The Board has not previously provided updates or clarification to the scope or intent of codes or standards during an active development process, allowing the development process to proceed to resolution. If a topic is contained in the scope or intent statement, it may be included either in the base of the code or as an appendix, as determined by the consensus body. Generally, appendices in the I-Codes fall under one of two categories: available for state/local adoption and for informational purposes only. In both cases, they undergo the rigors of the process no differently than text considered for the minimum requirements in the code. Each appendix in the respective I-Code notes the specific application of the appendix.

The Code Council provides the following direction:

> *Any content within the scope and intent of the code may be included either in the body of the code as minimum requirements or as an adoptable appendix based on the determination of the responsible Consensus Committee. Where content is to be included in an adoptable appendix, the appendix must include mandatory enforceable language.*

Cc: Dominic Sims, CEO