



DENVER AMENDMENT PROPOSAL FORM FOR PROPOSALS TO THE 2019 DENVER BUILDING CODE AMENDMENTS AND THE 2021 INTERNATIONAL CODES

DENVER
THE MILE HIGH CITY

2021 CODE DEVELOPMENT CYCLE

1) **Name:** Courtney Anderson **Date:** 10/12/2021
Email: Courtney.Anderson@denvergov.org **Representing (organization or self):**
City Staff Proposal (check box):

2) One proposal per this document is to be provided with clear and concise information.

Is a separate graphic file provided ("X" to answer): ___ Yes or No

3) Highlight the code and acronym that applies to the proposal

| <u>Acronym</u> | <u>Code Name</u> | <u>Acronym</u> | <u>Code Name</u> |
|----------------|--|----------------|--------------------------------|
| DBC-AP | Denver Building Code–Administrative Provisions | IPC | International Plumbing Code |
| IBC | International Building Code | IRC | International Residential Code |
| IECC | International Energy Conservation Code | IFGC | International Fuel Gas Code |
| IEBC | International Existing Building Code | IMC | International Mechanical Code |
| IFC | International Fire Code | DGC | Denver Green Code |

AMENDMENT PROPOSAL

Please provide all the following items in your amendment proposal.

Code Sections/Tables/Figures Proposed for Revision:

Instructions: If the proposal is for a new section, indicate (new), otherwise enter applicable code section.

C406.1

Add definitions as follows:

ALL-ELECTRIC PROPERTY. *A property that contains no permanently installed equipment or appliances that utilize combustion, plumbing for fuel gas or fuel oil or fuel gas utility connection, installed within the building(s) or site, except for emergency power systems and standby power systems.*

DEMAND RESPONSE SIGNAL. *A signal that indicates a price or a request to modify electricity consumption for a limited time period.*

DEMAND RESPONSIVE CONTROL. *A control capable of receiving and automatically responding to a demand response signal.*

DEMAND RESPONSE PROGRAM. *An agreement between a building occupant or building owner and third party such as a utility to install and operate demand responsive controls in the building that automatically adjust building operations in response to a demand response signal from the third party.*

COMBUSTION. *In the context of this code, refers to the rapid oxidation of fuel accompanied by the production of heat or heat and light.*

EMERGENCY POWER SYSTEM. *A source of automatic electric power of a required capacity and duration to operate required life safety, fire alarm, detection and ventilation systems in the event of a*

failure of the primary power. Emergency power systems are required for electrical loads where interruption of the primary power could result in loss of human life or serious injuries.

STANDBY POWER SYSTEM. A source of automatic electric power of a required capacity and duration to operate required building, hazardous materials or ventilation systems in the event of a failure of the primary power. Standby power systems are required for electrical loads where interruption of the primary power could create hazards or hamper rescue or fire-fighting operations.

Modify the sections as follows:

C406.1 Additional energy efficiency credit requirements. New buildings shall achieve a total of 10 credits from Tables C406.1(1) through C406.1(5) where the table is selected Table C406.1 in accordance with the credit requirements in Table C406.2 based on the use group of the building and from credit calculations as specified in relevant subsections of C406. Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

TABLE C406.1
Additional Energy Efficiency Credits for Denver

| Sub-section / Occupancy: | Group B | Group R and I | Group E | Group M | Other ^a Occupancies |
|--|-------------|---------------|---------|---------|--------------------------------|
| C406.2.1: 5% Heating Eff Imprv. | 1 | 1 | 1 | 2 | 1 |
| C406.2.2: 5% Cooling Eff Imprv. | 2 | 1 | 1 | 1 | 1 |
| C406.2.3: 10 % Heating Eff Imprv. | 2 | 2 | 3 | 3 | 3 |
| C406.2.4: 10 % Cooling Eff Imprv. | 4 | 1 | 2 | 2 | 2 |
| C406.2.5: >10% Cooling Eff Imprv. | See Section | | | | |
| C406.2.6: >10% Heating Eff Imprv. | See Section | | | | |
| C406.3: Reduced Light Power | 7 | 2 | 8 | 12 | 7 |
| C406.3.2: Reduced lighting power by 15% | 11 | 3 | 12 | 18 | 11 |
| C406.3.2: Reduced lighting power by >15% | See Section | | | | |
| C406.4: Enh. Digital Light Ctrl | 2 | NA | 2 | 3 | 2 |
| C406.5.1: On-site Renewable Egv. | 9-18 | 7-14 | 6-12 | 7-14 | 7-14 |
| C406.6: Dedicated OA Sys (DOAS) | 5 | 8 | NA | 2 | 5 |
| C406.7.2: Recovered/Renew SWH _b | NA | 14 | 1 | NA | 14 |
| C406.7.3: Eff fossil fuel SWH _b | NA | 9 | 2 | NA | 6 |
| C406.7.4: Heat Pump SWH _b | NA | 5 | 1 | NA | 5 |
| C406.8.1: Reduced envelope UA | 10 | 4 | 2 | 4 | 5 |
| C406.8.2: Further reduced envelope UA | 15 | 6 | 3 | 6 | 8 |
| C406.9.1: Reduced Air Infiltration | 4 | 5 | NA | 2 | 4 |
| C406.9.2: Further Reduced Air Infiltration | 7 | 8 | NA | 3 | 7 |
| C406.10 Energy Monitoring | 2 | 1 | 2 | 3 | 2 |
| C406.11 Fault Detection | 1 | 1 | 1 | 1 | 1 |
| C406.12 All-Electric Space Heating | 4 | 6 | 6 | 9 | 6 |
| C406.13: Cold Climate Heat Pumps | 4 | 5 | 5 | 9 | 6 |
| C406.14 All-Electric Water Heating | 9 | 13 | 13 | 4 | 9 |
| C406.15 Demand Responsive Thermostats | 1 | 1 | 1 | 1 | 1 |
| C406.16.1 Reduced Fan Power | 2 | NA | 6 | 7 | 3 |
| C406.16.2 Further Reduced Fan Power | 4 | NA | 11 | 14 | 6 |

- a. Other occupancy groups include all Groups except for Groups B, R, I, E, and M
b. For occupancy groups listed in C406.7.1.

TABLE C406.2
DENVER CREDIT REQUIREMENTS

| Building Type | Credit Requirement for <i>All-Electric Properties</i>^a | Credit Requirement for <i>All Other Buildings</i> |
|----------------------|--|--|
| Multifamily | 10 | 40 |
| Healthcare/Hospital | 10 | 40 |
| Hotel/Motel | 10 | 36 |
| Office | 10 | 31 |
| Retail | 10 | 35 |
| School | 10 | 24 |
| Warehouse | 10 | 48 |
| All Other | 10 | 40 |

a. Where the *all-electric property* complies with Sections C406.12 and C406.14. *All-electric properties* shall not be eligible for credits from Sections C406.12 and C406.14.

TABLE C406.1(1)
Additional Energy Efficiency Credits for Group B Occupancy

| Sub-section / Climate Zone: | 0A & 1A | 0B & 1B | 2A | 2B | 3A | 3B | 3C | 4A | 4B | 4C | 5A | 5B | 5C | 6A | 6B | 7 | 8 |
|----------------------------------|---------|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| C406.2.1: 5% Heating Eff Imprv. | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 1 | NA | NA | 1 | 1 | NA | 1 |
| C406.2.2: 5% Cooling Eff Imprv. | 6 | 6 | 5 | 5 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 1 |
| C406.2.3: 10% Heating Eff Imprv. | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | 2 | 1 | 1 | 2 | 2 | NA | 1 |
| C406.2.4: 10% Cooling Eff Imprv. | 11 | 12 | 10 | 9 | 7 | 7 | 6 | 5 | 6 | 4 | 4 | 5 | 3 | 4 | 3 | 3 | 3 |
| C406.3: Reduced Light Power | 9 | 8 | 9 | 9 | 9 | 9 | 10 | 8 | 9 | 9 | 7 | 8 | 8 | 6 | 7 | 7 | 6 |
| C406.4: Enh. Digital Light Ctrl | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 |
| C406.5.1: On-site Renewable Egy. | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| C406.6: Dedicated OA Sys (DOAS) | 4 | 4 | 4 | 4 | 4 | 3 | 2 | 5 | 3 | 2 | 5 | 3 | 2 | 7 | 4 | 5 | 3 |
| C406.7.2: Recovered/Renew SWH | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| C406.7.3: Eff fossil-fuel SWH | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| C406.7.4: Heat Pump SWH | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| C406.8: Enhanced Envelope Perf | 1 | 4 | 2 | 4 | 4 | 3 | NA | 7 | 4 | 5 | 10 | 7 | 6 | 11 | 10 | 14 | 16 |
| C406.9: Reduced Air Infiltration | 2 | 1 | 1 | 2 | 4 | 1 | NA | 8 | 2 | 3 | 11 | 4 | 1 | 15 | 8 | 11 | 6 |
| C406.10: Energy Monitoring | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| C406.11: Fault Detection | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

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

| Sub-section / Climate Zone: | 0A & 1A | 0B & 1B | 2A | 2B | 3A | 3B | 3C | 4A | 4B | 4C | 5A | 5B | 5C | 6A | 6B | 7 | 8 |
|----------------------------------|---------|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| C406.2.1: 5% Heating Eff Imprv. | NA | NA | NA | NA | 1 | NA | NA | 1 | NA | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 2 |
| C406.2.2: 5% Cooling Eff Imprv. | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | NA | 1 | 1 | NA | 1 | 1 | 1 | NA |
| C406.2.3: 10% Heating Eff Imprv. | NA | NA | NA | NA | 1 | NA | NA | 1 | 1 | 1 | 2 | 2 | 1 | 3 | 2 | 3 | 4 |
| C406.2.4: 10% Cooling Eff Imprv. | 5 | 5 | 4 | 3 | 2 | 3 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| C406.3: Reduced Light Power | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| C406.4: Enh. Digital Light Ctrl | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| C406.5.1: On-site Renewable Egy. | 8 | 8 | 8 | 8 | 7 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| C406.6: Dedicated OA Sys (DOAS) | 3 | 4 | 3 | 3 | 4 | 2 | NA | 6 | 3 | 4 | 8 | 5 | 5 | 10 | 7 | 11 | 12 |
| C406.7.2: Recovered/Renew SWH | 10 | 9 | 11 | 10 | 13 | 12 | 15 | 14 | 14 | 15 | 14 | 14 | 16 | 14 | 15 | 15 | 15 |
| C406.7.3: Eff fossil-fuel SWH | 5 | 5 | 6 | 6 | 8 | 7 | 8 | 8 | 8 | 9 | 9 | 9 | 10 | 10 | 9 | 10 | 11 |
| C406.7.4: Heat Pump SWH | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| C406.8: Enhanced Envelope Perf | 3 | 6 | 3 | 5 | 4 | 4 | 1 | 4 | 3 | 3 | 4 | 5 | 3 | 5 | 4 | 6 | 6 |
| C406.9: Reduced Air Infiltration | 6 | 5 | 3 | 11 | 6 | 4 | NA | 7 | 3 | 3 | 9 | 5 | 1 | 13 | 6 | 8 | 3 |
| C406.10: Energy Monitoring | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| C406.11: Fault Detection | 1 | 1 | 1 | 1 | 1 | 1 | NA | 1 | 1 | NA | 1 | 1 | NA | 1 | 1 | 1 | 1 |

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

| Sub-section / Climate Zone: | 0A & 1A | 0B & 1B | 2A | 2B | 3A | 3B | 3C | 4A | 4B | 4C | 5A | 5B | 5C | 6A | 6B | 7 | 8 |
|---------------------------------|---------|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|
| C406.2.1: 5% Heating Eff Imprv. | NA | NA | NA | NA | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 3 | 4 |

| | | | | | | | | | | | | | | | | | |
|-----------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| C406.2.2: 5% Cooling Eff Imprv. | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | NA | 1 | 1 | 1 | NA |
| C406.2.3: 10 % Heating Eff Imprv. | NA | NA | NA | 1 | 1 | 1 | 1 | 2 | 3 | 4 | 3 | 4 | 3 | 4 | 3 | 5 | 7 |
| C406.2.4: 10 % Cooling Eff Imprv. | 7 | 8 | 7 | 6 | 5 | 4 | 3 | 4 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 1 | |
| C406.3: Reduced Light Power | 8 | 8 | 8 | 9 | 8 | 9 | 9 | 8 | 9 | 9 | 8 | 9 | 8 | 7 | 8 | 7 | 7 |
| C406.4: Enh. Digital Light Ctrl | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| C406.5.1: On-site Renewable Egy. | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 |
| C406.6: Dedicated OA Sys (DOAS) | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| C406.7.2: Recovered/Renew SWH* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| C406.7.3: Eff fossil fuel SWH* | NA | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 5 |
| C406.7.4: Heat Pump SWH* | NA | NA | NA | NA | NA | NA | NA | 1 | NA | NA | 1 | 1 | NA | 1 | 1 | 1 | 1 |
| C406.8: Enhanced Envelope Perf | 3 | 7 | 3 | 4 | 2 | 4 | 1 | 1 | 3 | 1 | 2 | 3 | NA | 4 | 3 | 6 | 9 |
| C406.9: Reduced Air Infiltration | 1 | 1 | 1 | 2 | NA | NA | NA | NA | NA | NA | 1 | NA | NA | 4 | 1 | 4 | 3 |
| C406.10 Energy Monitoring | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| C406.11 Fault Detection | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |

c. For schools with showers or full service kitchens

TABLE C406.1(4)
Additional Energy Efficiency Credits for Group M Occupancy

| Sub-section / Climate Zone: | 0A & 1A | 0B & 1B | 2A | 2B | 3A | 3B | 3C | 4A | 4B | 4C | 5A | 5B | 5C | 6A | 6B | 7 | 8 |
|-----------------------------------|---------|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| C406.2.1: 5% Heating Eff Imprv. | NA | NA | NA | NA | 1 | 1 | NA | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 4 |
| C406.2.2: 5% Cooling Eff Imprv. | 5 | 6 | 4 | 4 | 3 | 3 | 1 | 2 | 2 | 1 | 1 | 2 | NA | 1 | 1 | 1 | NA |
| C406.2.3: 10 % Heating Eff Imprv. | NA | NA | NA | 1 | 1 | 1 | 1 | 2 | 2 | 4 | 3 | 4 | 5 | 5 | 3 | 6 | 8 |
| C406.2.4: 10 % Cooling Eff Imprv. | 9 | 12 | 9 | 8 | 6 | 6 | 3 | 4 | 4 | | 2 | 3 | NA | 2 | 2 | 1 | |
| C406.3: Reduced Light Power | 13 | 13 | 15 | 14 | 16 | 14 | 17 | 15 | 15 | 14 | 12 | 14 | 14 | 16 | 16 | 14 | 12 |
| C406.4: Enh. Digital Light Ctrl | 3 | 3 | 4 | 3 | 4 | 3 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 3 |
| C406.5.1: On-site Renewable Egy. | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 |
| C406.6: Dedicated OA Sys (DOAS) | 3 | 4 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 4 | 3 | 4 | 4 |
| C406.7.2: Recovered/Renew SWH | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| C406.7.3: Eff fossil fuel SWH | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| C406.7.4: Heat Pump SWH | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| C406.8: Enhanced Envelope Perf | 4 | 6 | 3 | 4 | 3 | 3 | 1 | 6 | 4 | 4 | 4 | 5 | 4 | 6 | 5 | 8 | 9 |
| C406.9: Reduced Air Infiltration | 1 | 1 | 1 | 2 | 1 | 1 | NA | 3 | 1 | 1 | 3 | 2 | 1 | 7 | 3 | 6 | 3 |
| C406.10 Energy Monitoring | 4 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 3 | 3 | 4 | 3 | 4 | 4 | 4 | 3 |
| C406.11 Fault Detection | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 |

TABLE C406.1(5)
Additional Energy Efficiency Credits for Other_a Occupancies

| Sub-section / Climate Zone: | 0A & 1A | 0B & 1B | 2A | 2B | 3A | 3B | 3C | 4A | 4B | 4C | 5A | 5B | 5C | 6A | 6B | 7 | 8 |
|--|---------|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| C406.2.1: 5% Heating Eff Imprv. | NA | NA | NA | NA | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 3 |
| C406.2.2: 5% Cooling Eff Imprv. | 5 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| C406.2.3: 10 % Heating Eff Imprv. | NA | NA | NA | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 3 | 5 | 5 |
| C406.2.4: 10 % Cooling Eff Imprv. | 8 | 9 | 8 | 7 | 5 | 5 | 3 | 4 | 4 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 2 |
| C406.3: Reduced Light Power | 8 | 8 | 9 | 9 | 9 | 9 | 10 | 8 | 9 | 9 | 7 | 8 | 8 | 8 | 8 | 8 | 7 |
| C406.4: Enh. Digital Light Ctrl | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 2 | 1 |
| C406.5.1: On-site Renewable Egy. | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| C406.6: Dedicated OA Sys (DOAS) | 3 | 4 | 3 | 3 | 4 | 3 | 2 | 5 | 3 | 3 | 5 | 4 | 3 | 7 | 5 | 7 | 6 |
| C406.7.2: Recovered/Renew SWH ^b | 10 | 9 | 11 | 10 | 13 | 12 | 15 | 14 | 14 | 15 | 14 | 14 | 16 | 14 | 15 | 15 | 15 |
| C406.7.3: Eff fossil fuel SWH ^b | 5 | 5 | 6 | 6 | 8 | 7 | 8 | 8 | 8 | 9 | 9 | 10 | 10 | 9 | 10 | 11 | 11 |
| C406.7.4: Heat Pump SWH ^b | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| C406.8: Enhanced Envelope Perf | 3 | 6 | 3 | 4 | 3 | 4 | 1 | 5 | 4 | 3 | 5 | 5 | 4 | 7 | 6 | 9 | 10 |
| C406.9: Reduced Air Infiltration | 3 | 2 | 2 | 4 | 4 | 2 | NA | 6 | 2 | 2 | 6 | 4 | 1 | 10 | 5 | 7 | 4 |
| C406.10 Energy Monitoring | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 3 | 2 |
| C406.11 Fault Detection | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

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

e. For occupancy groups listed in C406.7.1er

C406.2.5 More than ten percent cooling efficiency improvement. Where equipment exceeds the minimum annual cooling and heat rejection efficiency requirements by more than 10 percent, energy efficiency credits for cooling may be determined using Equation 4-12, rounded to the nearest whole number. Where multiple cooling performance requirements are provided, the equipment shall exceed the annual energy requirement, including IEER, SEER, and IPLV.

$$EEC_{CEC} = EEC_{10} \times [1 + ((CEI - 10 \text{ percent}) / 10 \text{ percent})] \quad \text{(Equation 4-12)}$$

EE_{CEC} = energy efficiency credits for heating efficiency improvement
 EE_{10} = C406.2.4 credits from Tables C406.1(1) through C406.1(5)
 CEI = ~~the lesser of:~~ the improvement above minimum cooling and heat rejection efficiency requirements, ~~or~~ 15 percent

C406.2.6 More than ten percent heating efficiency improvement. Where equipment exceeds the minimum annual heating efficiency requirements by more than 10 percent, energy efficiency credits for heating may be determined using Equation 4-13, rounded to the nearest whole number. Where multiple heating performance requirements are provided, the equipment shall exceed the annual energy requirement, including HSPF and COP.

$$EE_{HEC} = EE_{10} \times [1 + ((HEI - 10 \text{ percent}) / 10 \text{ percent})] \quad \text{(Equation 4-13)}$$

Where:

EE_{HEC} = energy efficiency credits for heating efficiency improvement

EE_{10} = C406.2.3 credits from Tables C406.1(1) through C406.1(5)

HEI = the improvement above minimum heating efficiency requirements **C406.5.2 Enhanced renewable credit.** Where the total minimum ratings of on-site renewable energy systems exceeds the rating in Section C406.5.1, additional energy efficiency credits shall be determined based on Equation 4-14, rounded to the nearest whole number. The credits shall not exceed the maximum credits indicated in Table C406.1. **C406.8 Enhanced envelope performance.** The total UA of the building thermal envelope as designed shall be not less than Section C406.8.1 or C406.8.2.

C406.8.1 Reduced envelope UA. 15 percent below the total UA of the building thermal envelope in accordance with Section C402.1.5.

C406.8.2 Further Reduced envelope UA. 25 percent below the total UA of the building thermal envelope in accordance with Section C402.1.5.

C406.9 Reduced air infiltration. Air infiltration shall be verified by whole-building pressurization testing conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air leakage rate of the building envelope shall ~~not exceed 0.25 cfm/ft² (2.0 L/s x m²)-be tested~~ under a pressure differential of 0.3 inches water column (75 Pa), with the calculated surface area being the sum of the above- and below-grade building envelope. A report that includes the tested surface area, floor area, air by volume, stories above grade, and leakage rates shall be submitted to the code official and the building owner. Buildings shall comply with Section C406.9.1 or C406.9.2.

Exception: For buildings having over 250,000 square feet (25 000 m²) of conditioned floor area, air leakage testing need not be conducted on the whole building where testing is conducted on representative above-grade sections of the building. Tested areas shall total not less than 25 percent of the conditioned floor area and shall be tested in accordance with this section.

C406.9.1 Reduced air infiltration. Air infiltration shall be verified in accordance with Section C406.9. The air leakage shall not exceed 0.25 cfm/ft² (2.0 L/s x m²).

C406.9.2 Further reduced air infiltration. Air infiltration shall be verified in accordance with Section C406.9. The air leakage shall not exceed 0.15 cfm/ft² (1.2 L/s x m²). Credits for this section shall not be combined with credits for Section C406.9.1.

Add the following sections:

C406.12 Electric Space Heating. All space heating shall be provided by electric equipment in accordance with this section. The total electric resistance load shall not exceed **5W per square foot of conditioned floor area for areas of the building served by Variable Air Volume systems and 1.35W per square foot of conditioned floor for all other areas of the building.**

Exceptions:

1. Electric resistance elements integrated into heat pump equipment
2. **Supplementary electric resistance heating**

C406.13 Cold climate heat pump. Space heating equipment shall be heat pumps that comply with the following:

1. Packaged Terminal Heat Pumps and Single Package Vertical Heat Pumps shall have a rated COP of not less than 1.5 when operating at @5°F.
2. All other heat pumps shall have a rated COP of not less than 1.75 when operating at @5°F.
3. The total electric resistance load of the building shall not exceed 1.35W per square foot of conditioned floor area of the building for all other buildings.

C406.14 Electric Water Heating. All service water heating shall be provided by electric water heating equipment.

C406.15 Demand responsive controls. All thermostatic controls serving the building shall be provided with *demand responsive controls* listed for participation in a *demand response program* that serves the *building site*.

C406.16 HVAC System Fan Power. The total design fan power for all HVAC units shall comply with Section C406.15.1 or C406.15.2.

C406.16.1 Reduced HVAC System Fan Power. The total design fan power for all HVAC units shall be no less than 10 percent lower than the fan power allowance defined in Table C403.8.1.

C406.16.2 Further reduced HVAC System Fan Power. The total design fan power for all HVAC units shall be no less than 20 percent lower than the fan power allowance defined in Table C403.8.1, Option 2.

Denver Green Code:

The Denver Green Code requires the following minimum number of credit points, in addition to meeting all applicable prescriptive requirements in 704.1. Compliance with the prescriptive path requires the installation on site PV generation.

TABLE C406.2
DENVER GREEN CODE CREDIT REQUIREMENTS

| <u>Building Type</u> | <u>Credit Requirement for</u> | <u>Credit Requirement for</u> |
|----------------------|-------------------------------|-------------------------------|
|----------------------|-------------------------------|-------------------------------|

| | <u>All-Electric Properties^a</u> | <u>All Other Buildings</u> |
|--|--|----------------------------|
| <u>Mid-Rise Apartment (R-2)</u> <u>Up to 7 stories</u> | <u>11</u> | <u>57</u> |
| <u>High-Rise Apartment (R-2)</u> <u>8 or more stories</u> | <u>11</u> | <u>44</u> |
| <u>Small Hotel (R-1)</u> <u>Up to 7 stories</u> | <u>11</u> | <u>44</u> |
| <u>Large Hotel (R-1)</u> <u>8 or more stories</u> | <u>11</u> | <u>40</u> |
| <u>Low and Mid-Rise Office (Group B)</u> <u>Up to 7 stories</u> | <u>11</u> | <u>34</u> |
| <u>Large Office (Group B)</u> <u>8 or more stories</u> | <u>11</u> | <u>53</u> |
| <u>Retail (Group M)</u> | <u>11</u> | <u>39</u> |
| <u>School (Group E)</u> | <u>11</u> | <u>26</u> |
| <u>Warehouse (Group S)</u> | <u>11</u> | <u>53</u> |
| <u>All Other</u> | <u>11</u> | <u>44</u> |

a: Where the *all-electric property* complies with sections C406.12 and C406.13.

Supporting Information (Required):

All proposals must include a written explanation and justification as to how they address physical, environmental, and/or customary characteristics that are specific to the City and County of Denver. The following questions must be answered for a proposal to be considered.

Reason for Revisions:

The Commercial Prescriptive Working Group met over a series of 4 meetings and recommended several modifications to the original proposal, including:

- **Space heating electrification option:** A committee working group was convened to refine the space heating electrification credit option (C406.12). The credit option was split into two credit options: a base credit for space heating electrification and an additional credit option for cold-climate heat pumps.
 - The base credit only requires electric equipment for space heating and sets a cap for electric resistance heating. A new limit of 5W/sf was added for VAV systems with electric resistance reheat along with an exception added for supplementary heat in alignment with the requirements developed by the WG for electrification. The existing limit of 1.35W/sf was maintained for all other systems. The prohibition of utilizing credit options for above code heating equipment was also removed since this credit option is now limited to just electrification.
 - The cold climate performance credit option includes only the cold-temperature COP performance requirement. Projects can get credit for the all-season efficiency from HSPF improvements from the existing C406.3 options. The credits from the original electrification measure were split between these two measures.
- **Combine all C406 proposals into a single proposal.** Only one of the C406 proposals impacted stringency (the proposal that set stringency), the others added flexibility through the addition of more credit options. The WG found it difficult to see C406 as a comprehensive whole of both increased stringency and increased options, so recommended putting all of the proposals together.
- **Definition of All-Electric Property.** The definition of “all-electric property” was modified to explicitly allow combustion for emergency and standby power. The WG wanted explicit clarity about how these systems fit into all-electric buildings. This was done in the definition since it was seen as useful for all building types, even residential occupancies, and because it was seen as the place that would provide the most clarity for users.
- **Building Type simplification:** The energy modeling WG decided to simplify the building type classifications to improve clarity, simplicity and alignment with Appendix G. The building types were simplified here as well to align the prescriptive and modeling paths. In this simplification the least stringent credit requirement for a building type was utilized.

- **New line-items in Table C406.1.** In a handful of places, increased levels of credits are available beyond those listed in the table. This makes it easy for design teams to miss opportunities to achieve credits. Additional line-items and/or notes were added for >10% performance improvement for space conditioning equipment and additional lighting power reduction. A credit range for on-site renewables was also added. These changes did not require changes to the actual requirements, since they are just meant to draw attention to existing credit options that are not obvious in the table. **A committee working group addressed comments about clarifying these additional lines by making their treatment consistent in the table. The table footnote for >15% reduction in lighting power was replaced with an additional row with a reference to the section.**
- **Renewables Cap:** A cap of 10% was added for onsite renewables credits. This was to align C406 with similar modifications made to the modeling path where the renewables cap was raised from 5% to 10%.
- **Calibrating Credit targets:** The credit targets for mixed fuel restaurants and retail were reduced from *Denver’s Net Zero Energy (NZE) New Buildings & Homes Implementation Plan* targets for the DEC-2022 in order to make them more achievable with available credits in the table. This highlights an issue discussed in the *Plan* that the prescriptive path is inherently limited in how far it can go in terms of efficiency, and that the practical limit of the prescriptive path is not the same for all building types.
- ~~**Space heating electrification option:** The credit option for space heating was modified to provide additional ways to comply with the credit requirements. Space heating would need to be either low energy resistance, cold climate HPs, or code compliant HPs paired with energy recovery.~~
- **Water heating electrification option:** The credit option for water heating electrification was modified to make it simpler. The requirement for HP water heating was eliminated to make it easier for projects to seek the electrification credits. The credit values were also reduced to recognize the lower value of the measures. Projects can still pursue additional credits for electric water heating through pursuing the increased efficiency credits.
- **Demand Responsive controls:** The demand responsive controls requirements were moved out of the proposed mandatory section of the code and made options in C406. The WG was concerned about the alignment between the requirements and DR program offerings that would be available to newly constructed buildings. The requirements for DR thermostats were modified so that they require controls that are currently approved for a local DR program instead of the original set of functional requirements. A definition for DR program was introduced to support this language.
- **Reduced Fan Power:** An additional option for reduced fan power was added. This was originally proposed for the main body of the code, but was moved here as an option. It includes two options for 10% and 20% fan power reduction.

Target Setting

The stringency levels in this proposal are based on the performance goals set for the 2022 DEC by *Denver’s Net Zero Energy (NZE) New Buildings & Homes Implementation Plan*. That performance target was set by plotting a trajectory from the 2019 DEC to NZE levels of performance. The NZE end target was set by surveying multiple published datasets of modeled and measured NZE potential.¹ The existing IECC delivers different levels of performance for different building types, with some building types closer to Denver’s NZE goal than others. This results in different performance improvement trajectories for those building types and different performance improvement targets for each code cycle for those building types. The DEC -2019 is about 7% more efficient than the IECC-2021 and about 9% more efficient than the 90.1-2019. This relationship between the DEC-2019 and IECC-2021 or 90.1-2019 and the performance improvements in the *Implementation Plan* for the DEC-2021 can be combined to calculate the improvement that is required beyond the IECC-2021 and 90.1-2019 for each building type. These percent improvements were then converted to the credit requirements for C406 and the BPF improvement for modeling.

Table 1: 2022 Code improvement targets

| Building Type | Improvement over DEC-2019 | Improvement over IECC-2021 | Improvement over 90.1-2019 |
|----------------------|----------------------------------|-----------------------------------|-----------------------------------|
| Multifamily (R-2) | 7% | 14% | 16% |
| Healthcare/Hospital | 7% | 14% | 16% |
| Hotel/Motel (R-1) | 6% | 13% | 15% |
| Office (Group B) | 5% | 12% | 14% |
| Retail (Group M) | 8% | 15% | 17% |
| School (Group E) | 7% | 14% | 16% |
| Warehouse (Group S) | 9% | 16% | 18% |

¹ Resources included the NBI Getting to Zero Database, the ASHRAE Advanced Energy Design Guides, The City of Toronto Zero Emissions Buildings Framework, GARD’s “Development of Maximum Technically Achievable Energy Targets for Commercial Buildings,” ARUP’s “Technical Feasibility of Zero Net Energy Buildings in California,” and “Built to Perform: An industry led pathway to a zero carbon ready building code.”

The proposal includes a separate set of targets for all-electric buildings. All-electric buildings only have to meet the 10-credit target from the 2021-IECC. Due to the decarbonization requirements of XCEL’s electrical supply by 2050, building electrification has a greater carbon benefit for all Denver building types over 50-year service life than the increased efficiency in “Denver’s Net Zero Energy (NZE) New Buildings & Homes Implementation Plan.” Therefore, the credit targets have been maintained at IECC-2021 levels for all-electric buildings.

- Purpose: What does your proposal achieve?

The purpose of this proposal is to calibrate the number of points required by IECC Section C406 to meet the performance goals set by the City of Denver for the next cycle of the Denver Energy Code in “Denver’s Net Zero Energy (NZE) New Buildings & Homes Implementation Plan.” It also sets specific targets based on building type in order to allow Denver to move all building types toward Denver’s NZE goal at a level rate.

- Reason (for original proposal): Why is your proposal necessary?

The 2021 edition of the IECC replaced the C406 package options with credits options. Rather than requiring projects to choose one of a list of efficiency packages, C406 now sets a credits target and offers a list of efficiency options with “efficiency credits” that vary by climate zone and building type. A building chooses one or more of these measures to achieve the credit target. This was done for two primary reasons:

- The existing packages delivered widely inconsistent savings across different building types and climate zones (from less than 1% to over 5% according to an analysis by the Pacific Northwest National Laboratory). By establishing different credit values for the measures for different building types in different climate zones, the credits approach delivers more consistent savings from Section C406.
- The credit target would make it easier for jurisdictions to increase the stringency of the prescriptive path in a way that was consistent and credible.

This structure has several advantages for Denver’s effort to increase the stringency of the energy code to meet the City’s climate goals:

- It allows the stringency of the prescriptive compliance path to be quickly and easily calibrated to Denver’s goals by simply changing the number of points required.
- It provides the maximum flexibility possible for projects using the prescriptive path since project teams will be able to choose which credit options are the most effective and cost effective for their particular project.
- It allows the custom elements of Denver’s code to be confined to Section C406, which offers related benefits:
 - It keeps Denver’s code requirements more aligned with those of neighboring jurisdictions since the efficiency requirements in the main body of the code remain the same. This will make compliance easier for the market, which will make enforcement easier for the City.
 - It requires little to no change to standard code compliance tools like COMCheck. In the 2019 code cycle, Denver adopted multiple amendments to the 2018 IECC, and had to work with the Department of Energy and Pacific Northwest National Lab to create a custom version of COMCheck. Denver had to wait while the modifications were made to COMCheck before it could be used. Additionally, while this task was paid for using state code support dollars from DOE, the budget for those dollars is fixed and may not be available after adoption.

- Substantiation: Why is your proposal valid? (i.e. technical justification)

The Proposal

One significant change that the proposal makes is that it restructures the tables that contain the credit values for each credit option. The IECC-2021 has a separate table for each building type with columns for each climate zone. Since Denver is in a single climate zone, these tables have been combined into a single table that only has the credit values for Denver’s climate zone, with each column representing a separate building type from the original tables.

Since the different building types are achieving different levels of performance under the IECC-2021 and are closer or further from Denver’s NZE goal, the proposal also replaces the single credit target in the IECC-2021 with a table that contains custom credit targets for each building type that will keep them moving on the trajectory required to meet Denver’s NZE goal.

The energy credit targets for the Denver Green Code represent a 10% whole building energy use improvement over the Denver base code. Compliance with the prescriptive approach can be demonstrated with a portion of the available energy credits, and may require either electrification of space heating and water heating loads, or additional onsite generation beyond the 50% Denver Green Code minimum (see proposal #4).

Related Proposals

Related proposals are also being submitted to increase the number of credits available for projects to use. This will provide increased flexibility in Section C406 for projects that need to meet a higher credit target. These include proposals to adjust the value of the existing infiltration reduction credits, to raise the cap on the number of points that can be obtained from efficient equipment, partial building electrification and to add credit options for higher performance thermal envelopes and further infiltration reduction.

If all of those additional proposals are approved, Table C406.1 would look like this:

TABLE C406.1
Additional Energy Efficiency Credits for Denver

| Sub-section / Occupancy: | Group B | Group R and I | Group E | Group M | Other ^a Occupancies |
|--|---------|---------------|---------|---------|--------------------------------|
| C406.2.1: 5% Heating Eff Imprv. | 1 | 1 | 1 | 2 | 1 |
| C406.2.2: 5% Cooling Eff Imprv. | 2 | 1 | 1 | 1 | 1 |
| C406.2.3: 10 % Heating Eff Imprv. | 2 | 2 | 3 | 3 | 3 |
| C406.2.4: 10 % Cooling Eff Imprv. | 4 | 1 | 2 | 2 | 2 |
| C406.3: Reduced Light Power | 7 | 2 | 8 | 12 | 7 |
| C406.4: Enh. Digital Light Ctrl | 2 | NA | 2 | 3 | 2 |
| C406.5.1: On-site Renewable Egv. | 9 | 7 | 6 | 7 | 7 |
| C406.6: Dedicated OA Sys (DOAS) | 5 | 8 | NA | 2 | 5 |
| C406.7.2: Recovered/Renew SWH _b | NA | 14 | 1 | NA | 14 |
| C406.7.3: Eff fossil fuel SWH _b | NA | 9 | 2 | NA | 9 |
| C406.7.4: Heat Pump SWH _b | NA | 5 | 1 | NA | 5 |
| C406.8.1: Reduced envelope UA | 10 | 4 | 2 | 4 | 5 |
| C406.8.2: Further reduced envelope UA | 15 | 6 | 3 | 6 | 8 |
| C406.9.1: Reduced Air Infiltration | 4 | 5 | NA | 2 | 4 |
| C406.9.2: Further Reduced Air Infiltration | 7 | 8 | NA | 3 | 7 |
| C406.10 Energy Monitoring | 2 | 1 | 2 | 3 | 2 |
| C406.11 Fault Detection | 1 | 1 | 1 | 1 | 1 |
| C406.12.1 Electric Space Heating | 21 | 30 | 30 | 35 | NA |
| C406.12.2 Electric Water Heating | 21 | 30 | 23 | 6 | NA |

- a. Other occupancy groups include all Groups except for Groups B, R, I, E, and M
b. For occupancy groups listed in C406.7.1 and schools with showers or full-service kitchens

These options provide plenty of opportunities for meeting the Denver credit target without employing on-site renewables. And with additional on-site renewables as allowed under section C406.5.1, projects also have the flexibility to use renewable energy to meet the requirement.

Bibliography and Access to Materials (as needed when substantiating material is associated with the amendment proposal):

Hart, Reid, Chandrasekharan Nambiar, Chitra, Tyler, Matthew T., Xie, YuLong, and Zhang, Jian. Relative Credits for Extra Efficiency Code Measures. United States: N. p., 2018. Web. doi:10.2172/1489162.
(https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28370.pdf)

Other Regulations Proposed to be Affected

***For proposals to delete content from the 2019 Denver Green Code in conjunction with adding it to other mandatory Denver codes and/or regulations, only.**

Please identify which other mandatory codes or regulations are suggested to be updated (if any) to accept relocated content.

None

Referenced Standards:

List any new referenced standards that are proposed to be referenced in the code.

None

Impact:

How will this proposal impact cost and restrictiveness of code? ("X" answer for each item below)

The proposal will increase the cost of construction through the increased stringency requirement. However, by leveraging C406 framework instead creating a suite of mandatory/prescriptive requirements throughout the rest of the code, buildings will have maximum flexibility to meet the increased efficiency requirements in the way that is most cost effective for each specific design.

Cost of construction: Increase ___ Decrease ___ No Impact
Cost of design: Increase ___ Decrease ___ No Impact
Restrictiveness: Increase ___ Decrease ___ No Impact

Departmental Impact (City use only):

This amendment proposal increases/decreases/is neutral to the cost of plans review.
This amendment increases/decreases/is neutral to the cost of inspections.