AMENDMENT PROPOSAL

Please provide all the following items in your amendment proposal.

**Code Sections/Tables/Figures Proposed for Revision:**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Code Name</th>
<th>Acronym</th>
<th>Code Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBC</td>
<td>International Building Code</td>
<td>IRC</td>
<td>International Residential Code</td>
</tr>
<tr>
<td>IEBC</td>
<td>International Existing Building Code</td>
<td>IMC</td>
<td>International Mechanical Code</td>
</tr>
<tr>
<td>IFC</td>
<td>International Fire Code</td>
<td>DGC</td>
<td>Denver Green Code</td>
</tr>
</tbody>
</table>

Add the following definition to Section C202:

**Predicted Energy Use Intensity (pEUI):** the annual site energy use of the *proposed design per square foot* in units of kBTU/sq.ft of building floor area.

Modify the section as follows:

**C401.2 Application.** Commercial buildings shall comply with C401.2.1 or C401.2.2.

**C401.2.1 International Energy Conservation Code.** Commercial buildings shall comply with one of the following:

1. Prescriptive Compliance. The Prescriptive Compliance Option requires compliance with Sections C402 through C406 and C408.

2. Total Building Performance. The Total Building Performance Option requires compliance with Section C407.

**Exception:** Additions, alterations, repairs and changes of occupancy to existing buildings complying with Chapter 5.

**C401.2.2 ASHRAE 90.1.** Commercial buildings shall comply with the requirements of ANSI/ASHRAE/IESNA 90.1.
Replace Section C407 with the following:

SECTION C407
MODIFICATIONS TO ASHRAE 90.1

C407.1 Scope. This section establishes criteria for demonstrating compliance with Appendix G of ANSI/ASHRAE/IESNA 90.1.

C407.1.1 Additions to Existing Buildings. When an addition to an existing building cannot comply by itself, trade-offs will be allowed by modification to one or more of the existing components of the existing building. Modeling of the modified components of the existing building and addition shall employ the procedures Normative Appendix G. The addition shall not increase the energy consumption of the existing building plus the addition beyond the energy that would be consumed by the existing building plus the addition if the addition alone did comply.

C407.2 Mandatory Requirements. In addition to the mandatory requirements identified in Section G1.2.1 of Appendix G of ANSI/ASHRAE/IESNA 90.1, new buildings shall comply with the requirements of the sections indicated within Table C407.2. The modeling documentation for all buildings shall include the pEUI of the proposed design as calculated in accordance with Appendix G of ANSI/ASHRAE/IESNA 90.1. Energy use from process loads sub-metered in accordance with Section C405.12 shall be permitted to be excluded from this calculation. For the purposes of this section, plug loads in healthcare/hospital occupancies shall be considered process loads.

TABLE C407.2
REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

<table>
<thead>
<tr>
<th>SECTIONa</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>C403.4.1.6</td>
<td>Demand responsive thermostats</td>
</tr>
<tr>
<td>C404.11</td>
<td>Demand Responsive Water Heating</td>
</tr>
<tr>
<td>C405.12</td>
<td>Energy monitoring</td>
</tr>
<tr>
<td>C405.13</td>
<td>Minimum renewable energy system capacity</td>
</tr>
<tr>
<td>C405.14</td>
<td>Electric vehicle charging infrastructure</td>
</tr>
<tr>
<td>C405.15</td>
<td>Minimum renewable energy system capacity</td>
</tr>
<tr>
<td>C408</td>
<td>Acceptance Testing</td>
</tr>
</tbody>
</table>

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

C407.3 Compliance based on Energy Cost. Buildings complying with Appendix G of ANSI/ASHRAE/IESNA 90.1 based on energy cost shall comply with this section.

C407.3.1 Compliance. Buildings shall comply with the provisions of Appendix G of ANSI/ASHRAE/IESNA 90.1, “Performance Rating Method.” The Performance Cost Index (PCI) shall
be less than or equal to the Performance Cost Index Target (PCIₜ) when calculated in accordance with the following:

\[
\text{PCIₜ} = \frac{\text{DTA} \times [\text{BBUEC} + (\text{ECBP} \times \text{BBREC})]}{\text{BBP}}
\]

where

\text{PCI} = \text{Performance Cost Index calculated in accordance with Section G1.2 of Appendix G of ANSI/ASHRAE/IESNA 90.1.}

\text{DTA} = \text{Denver Target Adjustment from Table C407.3. For building area types not listed in Table C407.1 use “All others.” Where a building has multiple building area types, the DTA shall be equal to the area-weighted average of the building area types.}

\text{BBUEC} = \text{Baseline Building Unregulated Energy Cost, the portion of the annual energy cost of a baseline building design that is due to unregulated energy use.}

\text{BBREC} = \text{Baseline Building Regulated Energy Cost, the portion of the annual energy cost of a baseline building design that is due to regulated energy use.}

\text{ECBP} = \text{Energy Cost Building Performance Factor from Table C407.3. For building area types not listed in Table C407.1 use “All others.” Where a building has multiple building area types, the required ECBP shall be equal to the area-weighted average of the building area types.}

\text{BBP} = \text{Baseline Building Performance.}

Regulated energy cost shall be calculated by multiplying the total energy cost by the ratio of regulated energy use to total energy use for each fuel type. Unregulated energy cost shall be calculated by subtracting regulated energy cost from total energy cost.

**TABLE C407.3**

DENVER TARGET ADJUSTMENT (DTA) and BUILDING PERFORMANCE FACTOR (ECBP)

<table>
<thead>
<tr>
<th>Building Type</th>
<th>DTA</th>
<th>ECBP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-Rise and Mid-Rise Multifamily (R-2) Up to 7 stories</td>
<td>0.81</td>
<td>0.73</td>
</tr>
<tr>
<td>High-Rise Multifamily (R-2) 8 or more stories</td>
<td>0.84</td>
<td>0.73</td>
</tr>
<tr>
<td>Small Hotel (R-1) 0-100,000</td>
<td>0.84</td>
<td>0.51</td>
</tr>
<tr>
<td>Large Hotel (R-1) 100,000 sf and larger</td>
<td>0.87</td>
<td>0.51</td>
</tr>
<tr>
<td>Healthcare/Hospital</td>
<td>0.84</td>
<td>0.52</td>
</tr>
<tr>
<td>Small and Medium Office (Group B)</td>
<td>0.86</td>
<td>0.51</td>
</tr>
<tr>
<td>Up to 100,000 sf</td>
<td>Large Office (Group B)</td>
<td>0.82</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------</td>
<td>------</td>
</tr>
<tr>
<td>100,000 sf and larger</td>
<td>Restaurant</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>Retail (Group M)</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>School (Group E)</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td>Warehouse (Group S)</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>All Other</td>
<td>0.84</td>
</tr>
</tbody>
</table>

**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.

**Purpose:** What does your proposal achieve?

This proposal eliminates the C407 compliance path from the IECC and Chapter 11 from 90.1, leaving Appendix G as the sole modeled performance compliance path. It also eliminates the prescriptive path in ASHRAE 90.1 as a compliance option.

**Reason:** Why is your proposal necessary?

As Denver increases the stringency of the Denver Energy Code beyond the AHSRAE and ICC model codes, it is increasingly challenging to modify the 5 compliance paths in the 2021 IECC (IECC-Prescriptive, IECC-C407, 90.1-Prescriptive, 90.1-Ch11, and 90.1-Appendix G) to allow them to meet Denver’s efficiency goals and also to calibrate them to the same level of efficiency. The multiple paths also create complexity for code users and challenges for effective code enforcement. Therefore, “Denver’s Net Zero Energy (NZE) New Buildings & Homes Implementation Plan” includes a goal to create greater consistency in performance outcomes in new Denver buildings by limiting the number of compliance paths in the Denver Energy Code. This proposal reduces the compliance paths to just the prescriptive path in the IECC and the modeling approach in Appendix G from ASHRAE 90.1. The modeling approach from Appendix G was chosen because this modeling methodology has received consistent development with each development cycle of ASHRAE Standard 90.1. This development has enabled the modeling path to more fully incorporate enhancements to the prescriptive path and to more clearly define modeling parameters and variables. Conversely, the modeling path Section C407 of IECC has not received any development since the 2012 code cycle. It does not include all of the prescriptive elements of the code in the methodology. In 2012, the 15% performance factor was added in order to roughly re-sync the energy performance outcomes expected from the prescriptive path with the modeling methodology in Section C407. However, this performance factor was an estimate in 2012 and has never been validated or updated. As a result, the modeling path in the IECC is less robust than the modeling path in 90.1 and far more difficult to accurately calibrate to Denver’s goal.

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

**Compliance Paths:**

The modifications to Section C401.2 make the changes to which compliance paths are available.

**Appendix G:**

The Denver Energy Code cannot make direct changes to ASHRAE Standard 90.1. For this reason, the 2019 Denver Energy Code includes necessary modifications to Appendix G in the DEC itself. This was done in Section C401, which was somewhat awkward. The elimination of the C407 modeling compliance path frees up Section C407 for making these modifications.

The proposal makes the following changes to Appendix G.

- It calibrates Appendix G to Denver’s Energy Code goals (see calibration discussion below).
- It adds a requirement to report site energy to modeling documentation to support the Implementation Plan’s goal of a future transition to the usage of modeling targets.
- It adds the electrification readiness, demand responsive controls and electric vehicle charging infrastructure requirements being proposed for the 2021 DEC as requirements for projects utilizing Appendix G since these are not included in the mandatory minimums in Standard 90.1.
- It replicates and modifies all of the charging and guidance language from ASHRAE 90.1 Section 4 in the new C407. C407 effectively takes the place of 90.1, Section 4 which makes Appendix G (and its reference) the only part of ASHRAE 90.1 used in the DEC.
- It removes the limit in 90.1-2019 on the amount of renewable energy that can be used for compliance. With Denver’s performance and renewable energy goals, buildings will generally need to incorporate more renewable energy than 5%.

4/14/21
• The methodology allows large, sub-metered process loads to be excluded from the calculation since the DTA is applied to total building energy. It also allows healthcare plug loads to be considered process loads.

Calibrating the Modeling Paths:
ASHRAE 90.1-2019 and IECC 2021 represent different levels of performance (see graphic below). Therefore, the level of performance improvements required to meet Denver’s climate goals are not the same for the IECC and 90.1.

Additionally, the existing IECC and 90.1 deliver different levels of performance for different building types. Based on an analysis of building performance by New Buildings Institute, Denver’s Implementation Plan includes the percent savings that will need to be achieved in each code cycle to ultimately achieve Denver’s NZE goal (see table below and the Energy Performance Targets in Code section of the Implementation Plan for more information). The DEC 2019 is 10% more efficient than 90.1-2019. This relationship between the DEC 2019 and 90.1-2019 and the performance improvements in the Implementation Plan for the DEC 2021 can be combined to determine the improvement that is required beyond 90.1-2019. This factor is included in the calculation of the Performance Cost Index Target (PCI) used in ASHRAE 90.1 to calibrate it to the performance target for each building type. These building by building “Denver Target Adjustment” (DTA) factors are included in a table with the ASHRAE 90.1 building performance factors (BPFs).

Bibliography and Access to Materials (as needed when substantiating material is associated with the amendment proposal):
Nothing

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.
Nothing

Referenced Standards:
List any new referenced standards that are proposed to be referenced in the code.
Nothing

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.

The proposal will increase the cost of construction through the increased stringency requirement.

Cost of construction: __X_ Increase ___Decrease ___No Impact
Cost of design: ___X_ Increase ___Decrease ___No Impact
Restrictiveness: ___X_ Increase ___Decrease ___No Impact

Bibliography and Access to Materials (as needed when substantiating material is associated with the amendment proposal):
Nothing

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Nothing

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Cost of construction: __X_ Increase ___Decrease ___No Impact
Cost of design: ___X_ Increase ___Decrease ___No Impact
Restrictiveness: ___X_ 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.