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

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

Acronym	Code Name	Acronym	Code Name
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.
C401.2

Add the following definitions to Section C202:

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.*

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.

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 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:

C407.1 Scope. This section establishes criteria for demonstrating compliance using total building performance in accordance with option c of section 4.2.1.1 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 of section 407. 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.

C407.1.2 Relationship to Energize Denver. The requirements of this section are intended to support the *buildings'* future compliance with the requirements of the Energize Denver Building Energy Performance Requirements when the *building* is operated efficiently.

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, *buildings* shall comply with the following:

1. The requirements of the sections indicated within Table C407.2.
2. The *pEUI* of the *proposed design* as calculated in accordance with Appendix G of ANSI/ASHRAE/IESNA 90.1 shall be included in the documentation required by section G1.3.2.
3. The construction documents shall include the final 2030 target EUI required by Energize Denver (ordinance number 20211310) applicable to the *building*. The EUI shall be determined in accordance with the *Rules and Regulations Governing Energize Denver Building Energy Performance Requirements* document available from the Office of Climate Action, Sustainability and Resiliency.
4. Performance modeling utilized to meet the requirements of this section shall be conducted under the supervision of a professional who holds an ASHRAE Building Energy Modeling Professional Certification or *approved* equivalent certification. The name, affiliation and contact information of the modeler who supervised the performance modeling shall be included in the documentation required by section G1.3.2.
5. *Buildings* shall comply with section C405.12 in lieu of section 8.4.3 of ASHRAE 90.1.
6. *Buildings* shall comply with section C408 in lieu of section 4.2.5 of ASHRAE 90.1.

TABLE C407.2
REQUIREMENTS FOR TOTAL BUILDING PERFORMANCE

SECTION[a]	TITLE
C404.11	Demand Responsive Water Heating
C405.14	Electric vehicle charging infrastructure

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* shall comply with option c: Normative Appendix G, "Performance Rating Method" of section 4.2.1.1 of ANSI/ASHRAE/IESNA 90.1 as modified by this section.

C407.3.1 Building performance factors. Table 4.2.1.1 Building Performance Factor (BPF) shall be replaced with Table C407.3.

C407.3.2 Renewable energy. Section 4.2.1.1 of ANSI/ASHRAE/IESNA 90.1 shall be modified as follows:

When $(PBP_{nre} - PBP)/BBP > \sout{0.05}\ 0.10$, new *buildings*, *additions* to *existing buildings*, and/or *alterations* to *existing buildings* shall comply with the following:

$$PCI + [(PBP_{nre} - PBP)/BBP] - \sout{0.05}\ 0.10 < PCI_t$$

C407.3.3 Process load metering. *Process loads* as defined in ANSI/ASHRAE/IESNA 90.1 that are categorized as *unregulated energy use* for the purposes of Normative Appendix G shall be metered separately from the rest of the *building* with meters or other measurement devices that comply with section C405.12.3.

TABLE C407.3
BUILDING PERFORMANCE FACTOR (BPF)

Building Type	*All-electric properties*	All other *buildings*
Multifamily (R-2)	0.78	0.66
Healthcare/Hospital	0.70	0.59
Hotel/Motel (R-1)	0.71	0.60
Office (Group B)	0.57	0.49
Restaurant	0.63	0.53
Retail (Group M)	0.49	0.41
School (Group E)	0.58	0.49
Warehouse (Group S)	0.29	0.24
All Other	0.58	0.49

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

- **Overall simplification and streamlining.** The original proposal included a "Denver Target Adjustment" factor to implement *Denver's Net Zero Energy (NZE) New Buildings & Homes Implementation Plan* targets for the DEC-2022. This factor was applied to total building energy, effectively requiring reductions in both regulated and unregulated energy. The WG was concerned about the practicality of getting enough additional savings from the regulated loads to generate the required savings in the unregulated loads under this approach. The proposal was modified so that the DTA was applied only to the Building Performance Factors utilized in Appendix G, limiting the impact to only regulated loads. This significantly simplifies the proposal since the only thing in the Appendix G calculation methodology that needs to be changed is to replace the 90.1-2019 BPFs with a set of BPFs calibrated to Denver's goals. It results in less stringency in the proposal, but the simplification with significantly ease the transition to Appendix G.
- **Move site energy to an Appendix.** The WG identified the inclusion of site energy and energy cost provisions together in C407 as a source of potential confusion. Therefore, the site energy approach was moved to an appendix to allow C407 to stand as a "standard" modeling approach that is as close to Appendix G and to remove the potential for users to confuse which code sections applied to energy cost and which applied to site energy. The appendix includes a reference to the mandatory requirements in C407 to ensure consistency between the modeling paths.
- **Integration with Energize Denver.** The WG was concerned about the potential of this code path resulting in buildings that do not meet the requirements of Energize Denver. As a result, two new sections were added. The first is just an informative statement about the connection between the code and Energize Denver. The second is a requirement that the Energize Denver EUI target that will be applied to the building has to be included as part of the modeling documentation along with the modeled pEUI of the building. This will require design teams to pay attention to this important connection.
- **Modeler certification.** The WG discussed how much to regulate the modeling process and whether additional regulations were required to ensure quality models that were more likely to deliver the expected performance level. The WG expressed a desire to focus on creating additional standards for the modelers rather than the models themselves in order to allow modelers necessary professional discretion. Therefore, a requirement was added that the model would need to be done under a modeler with the ASHRAE Building Energy Modeling Professional Certification. While this discussion was primarily concerned with the energy target modeling path, the WG felt it was appropriate for all of the modeling approaches.
- **BPFs.** For the 2022 version of 90.1, a new methodology is being utilized to generate the BPFs. This methodology is more accurate and generally results in less stringent BPFs. PNNL utilized this new methodology to generate revised BPFs for Denver specifically for 90.1-2019 levels of performance.
- **Consistency with prescriptive path.** The proposal also replaced the 90.1 requirements for energy monitoring and acceptance testing / commissioning with the IECC requirements. This was in order to ensure consistency among Denver projects regardless of compliance path.
- **Building Type simplification:** The WG felt that the subdivisions of the building types added confusion. The WG felt that reverting to the building type classifications in Appendix G was beneficial since it was clearer and reduced the modifications to the standard Appendix G that modelers would be using outside of Denver. The WG recognized that the different prototypes used for target-setting in the *Implementation Plan* may result in different results on a prototype basis, but that the real-world difference in Denver was not so pronounced. In this simplification the least stringent performance improvement for a building type was utilized.
- **Renewable energy cap.** The WG felt that the cap on renewable energy that could be counted toward compliance was too restrictive given Denver's goals. The cap was therefore raised to 10% in order to allow for more flexibility without allowing too much tradeoff between renewable energy and fundamental efficiency. This also aligns the modeling path with changes made to C406 by the commercial prescriptive WG.

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 that 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-2021and 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%

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 (for original proposal): 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.

[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."

- 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%.
- 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.

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

None

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.

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

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.