



# 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:** Rebecca Esau (RMI) **Date:** November 22 2021  
 Webly Bowles (NBI)  
**Email:** [resau@rmi.org](mailto:resau@rmi.org) **Representing (organization or self):** RMI & NBI  
[webly@newbuildings.org](mailto:webly@newbuildings.org)

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	<b>DGC</b>	<b>Denver Green Code</b>

## 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.

---

**Proposal:**  
**Instructions:** Show the proposal using ~~strikeout~~, underline format.  
**Place an "X" next to the choice that best defines your proposal:** \_\_\_ Revision  New Text \_\_\_ Delete/Substitute \_\_\_ Deletion

*Add new definitions as follows:*

**carbon dioxide equivalent (CO2e):** A measure used to compare the impact of various greenhouse gases based on their global warming potential (GWP). CO2e approximates the time-integrated warming effect of a unit mass of a given greenhouse gas relative to that of carbon dioxide (CO2). GWP is an index for estimating the relative global warming contribution of atmospheric emissions of 1 kg of a particular greenhouse gas compared to emissions of 1 kg of CO2. The following GWP values are used based on a 100-year time horizon: 1 for CO2, 25 for methane (CH4), and 298 for nitrous oxide (N2O).

**Environmental Product Declaration (EPD):** independent third-party multi-attribute product declaration or certification containing documentation consistent with ISO Standards 14025 and 21930, with at least cradle-to-gate scope.

**Community renewable energy facility.** A facility that produces energy harvested from renewable energy resources and is qualified as a community energy facility under applicable jurisdictional statutes and rules.

**Physical Renewable Energy Power Purchase Agreement (PPA).** A contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.

**Financial Renewable Energy Power Purchase Agreement (PPA).** A financial arrangement between a renewable electricity generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the

project’s renewable generation. Also known as a “financial power purchase agreement” and “virtual power purchase agreement.”

Add new section as follows:

**901.3.2.2 Embodied CO2e for steel products.** Structural steel, hollow steel section, steel plate, and concrete reinforcing steel bar products used in the building project shall comply with Sections 901.3.2.2.1 and 901.3.2.2.2.

**901.3.2.2.1 EPD Disclosure.** Product-specific Type III Environmental Product Declarations (EPDs) shall be submitted for a minimum of 75% of steel products, based on cost or weight. Type III EPDs used for compliance with this section shall be certified as complying with the goal and scope for the cradle-to-gate requirements in accordance with ISO Standards 14025 and 21930 and be available in a publicly accessible database.

**901.3.2.2.2 Steel Performance.** A minimum of 75% of steel products listed in this section, based on cost or weight, shall be produced in a facility or facilities that comply with one or more of the following:

1. A minimum of 80% of steel products listed in this section, based on cost, shall not exceed the total CO2e values in Table 901.3.2.2 based on product type.

**Table 901.3.2.2  
CO2e Limit per Steel Product**

	<u>Steel Product</u>	<u>Mill kg CO2e/kg (1)</u>	<u>Fabrication kg CO2e/kg (2)</u>
<u>Structural Steel</u>	<u>Structural Sections</u>	<u>1.49</u>	<u>1.83</u>
	<u>Hollow Structural Sections</u>	<u>2.57</u>	<u>2.99</u>
	<u>Plate</u>	<u>2.21</u>	<u>2.60</u>
<u>Concrete Reinforcing Steel Bars</u>		<u>0.89</u>	<u>1.01</u>

1: Use this column to determine compliance when an EPD declares mill-only material (cradle to mill gate).

2: Use this column to determine compliance when an EPD declares mill material plus U.S. industry average fabrication impacts (cradle to fabricator gate).

2. On the date of procurement is independently, or as part of an aggregation of facilities, a Green Power Partner in the US EPA Green Power Partnership program, or an equivalent renewable power procurement registry for production outside of the United States.
3. Not less than 50% of the energy sourced for production at the facility is a renewable energy resource as documented from one or more of the following:
  1. On-site renewable energy system
  2. Off-site renewable energy system owned by the production facility owner
  3. Community renewable energy facility
  4. Physical Renewable Energy PPA
  5. Financial Renewable Energy PPA

**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?**

The purpose of this proposal is to increase the number of Environmental Product Declarations (EPDs) for steel products by requiring disclosure of carbon dioxide equivalent (CO2e) content for structural steel and rebar products specified in the project. This proposal will reduce the embodied carbon impact of new building construction by applying carbon dioxide equivalent (CO2e) limits for the steel products specified in the project.

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

Building operations and building construction are responsible for 39% of today’s global carbon emissions.<sup>1</sup> About 11% of these emissions are embodied carbon emissions, the emissions associated with building materials and construction activities.<sup>1</sup>

Over the next 5 years, projections show Denver will construct about 54 million ft<sup>2</sup> of new buildings.<sup>2</sup> Denver’s Climate Action Plan has set specific goals for reducing building energy use, including a 50% reduction in commercial building energy use by year 2050. As the operational efficiency of Denver’s buildings increases, embodied carbon is becoming an ever more significant source of emissions. Unlike operational emissions, which can be improved over the lifespan of a building through deep-energy retrofits and the decarbonization of the electric grid, the majority of embodied carbon emissions occur before a building is occupied and cannot be reduced over time. Therefore, addressing embodied carbon in the construction of buildings presents an urgent and valuable opportunity to reduce carbon emissions in Denver.

Commercial & Multifamily Buildings	5-Year Increase (sqft)
Apartments & Condos	19,300,199
Office and Bank	6,716,497
Warehouses	1,725,054
Hotels	1,638,085
Schools	1,289,142
Misc. Non-Res	1,200,500
Hospitals	1,158,273
Stores/Restaurants	1,106,037

Source: Dodge Data and Analytics – Denver City and County New Construction Projections

Homes	5-Year Increase (sqft)
One Family Houses	18,876,629
Two Family Houses	859,211

Source: Dodge Data and Analytics – Denver City and County New Construction Projections

Denver’s Net Zero Energy New Buildings & Homes Implementation Plan, Page 21

Steel is one of the most widely used materials in building construction and a primary contributor to embodied carbon in buildings. The US steel industry is responsible for 104.6 MMT of CO<sub>2</sub> emissions annually, a contribution that makes up 2% of total US emissions.<sup>3</sup> Steel destined for the built environment is responsible for 46 MMT of CO<sub>2</sub> emissions annually, nearly half of the total annual emissions from the steel industry.<sup>3</sup>

Many types of steel products made with different manufacturing techniques are found in buildings. Structural steel sections is the predominant structural framing material used in building construction, holding 46% of the market share for structural framing materials for nonresidential and multistory residential construction in 2017.<sup>4</sup> Steel reinforcing or “rebar,” which is typically embedded in structural concrete, can also be a major use of steel and source of embodied carbon in buildings.

A recent case study analysis by RMI shows that simply by specifying rebar products with lower CO<sub>2</sub>e content, the embodied carbon of a typical commercial construction project can be reduced up to 10%.<sup>5</sup>

Denver can drive significant embodied carbon reductions by collecting the data needed to implement regulations that address the reduction of CO<sub>2</sub>e in steel products used in building construction. Including embodied carbon considerations in building code will not only decrease the carbon impact of Denver’s building construction industry, but it will also support local economic development towards low carbon business models.

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

Although steel is one of the most widely used materials in the construction of new buildings, few steel manufacturers provide Environmental Product Declarations (EPDs) for their products. An EPD discloses the environmental impact of a product including the product’s carbon dioxide equivalent (CO<sub>2</sub>e) as represented as global warming potential (GWP). GWP is the most common metric for measuring and evaluating materials’ greenhouse gas emissions over

a product or building's lifecycle, also called embodied carbon. Third-party rating systems like LEED, and procurements policies like the U.S. General Services Administration's (GSA) Recommendations for Procurement of Low Embodied Carbon Materials,<sup>6</sup> have put demand on building product manufacturers to disclose the environmental impacts of their products, but steel manufacturers have been slow to respond to these demands.

The current regional EPD data pool for structural steel, hollow steel section, and steel plate is not yet sufficient to support a code requirement that applies CO<sub>2</sub>e limits for these materials. However, industry-wide EPDs provide a datapoint, disclosing a GWP that 50% of the market can achieve. The proposal GWP value is based on 150% of the industry average as identified in American Institute of Steel Construction and Steel Tube Institute's Type III industry-wide EPD. Setting GWP limits for structural steel sections, steel plate, and hollow structural sections at 150% of the industry average allows a wide range of complying manufacturers and encourage the bottom 20% of the industry to improve. In addition, the steel industry EPDs are based primarily on American steel data meaning that American efficiency is setting the standard, often requiring imported steel to rise to a higher efficiency level. Disclosure of CO<sub>2</sub>e content in steel is a critical first step in increasing a regional supply of data that can eventually be used to apply CO<sub>2</sub>e limits to reduce the environmental impact of steel used in building construction. By requiring the reporting of EPDs for hot-rolled steel and rebar, demand for EPDs for steel products will increase and prime the market for future regulation.

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

[1] *Bringing Embodied Carbon Upfront: Coordinated Action for the Building and Construction Sector to Tackle Embodied Carbon*, World Green Building Council, 2019, [https://www.worldgbc.org/sites/default/files/WorldGBC\\_Bringing\\_Embodied\\_Carbon\\_Upfront.pdf](https://www.worldgbc.org/sites/default/files/WorldGBC_Bringing_Embodied_Carbon_Upfront.pdf)

[2] *Denver's Net Zero Energy New Buildings & Homes Implementation Plan*, January 2021, Page 21, [https://denvergov.org/files/assets/public/climate-action/documents/denver-nze-implementation-plan\\_final\\_v1.pdf](https://denvergov.org/files/assets/public/climate-action/documents/denver-nze-implementation-plan_final_v1.pdf)

[3] *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990–2018*, US Environmental Protection Agency, 2020, <https://www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-2020-main-text.pdf>

[4] *Structural Steel: An Industry Overview*, American Institute of Steel Construction, August 2018, [https://www.aisc.org/globalassets/aisc/publications/white-papers/structural\\_steel\\_industry\\_overview\\_2018.pdf](https://www.aisc.org/globalassets/aisc/publications/white-papers/structural_steel_industry_overview_2018.pdf).

[5] Matt Jungclaus, Rebecca Esau, Victor Olgyay, and Audrey Rempher, *Low-Cost, High-Value Opportunities to Reduce Embodied Carbon in Buildings*, RMI, forthcoming 2021.

[6] *GSA Green Building Advisory Committee Advice Letter: Policy Recommendations for Procurement of Low Embodied Energy and Carbon Materials by Federal Agencies*, U.S. General Services Administration, February 17 2021, <https://www.gsa.gov/governmentwide-initiatives/federal-highperformance-green-buildings/policy/green-building-advisory-committee/advice-letters-and-resolutions>

[7] American Institute of Steel Construction, Environmental Product Declaration, Fabricated Hot-Rolled Structural Sections, January 1, 2021, <https://www.aisc.org/globalassets/why-steel/epd-aisc-hr-sections-2021.pdf>

[8] American Institute of Steel Construction, Environmental Product Declaration, Fabricated Steel Plate, January 1, 2021, <https://www.aisc.org/globalassets/why-steel/epd-aisc-plate-2021.pdf>

[9] American Institute of Steel Construction and Steel Tube Institute, Environmental Product Declaration, Fabricated Hollow Structural Sections, December 15, 2021, [draft]

**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.

N/A

**Referenced Standards:**

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

ISO Standards 14025 and 21930

**Impact:**

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

Cost of construction:    \_\_\_ Increase    \_\_\_ Decrease    \_X\_ No Impact  
Cost of design:            \_\_\_ Increase    \_\_\_ Decrease    \_X\_ 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.