Code Amendment Proposal Form
For public amendments proposed to the 2018 editions of the International Codes

Instructions: Upload this form and all accompanying documentation at www.denvergov.org/BuildingCode. If you are submitting your proposal on a separate sheet, make sure it includes all information requested below.

All proposals must be received by April 26, 2019.

_______________________________________________________________

CONTACT INFORMATION

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Organization: Denver Dept of Public Health and Environment

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Signature: ____________________________

Co-proposed by: Matt Frommer, Southwest Energy Efficiency Project
Jim Burness, National Car Charging
Anthony Harrison, Chargepoint
Nate Huyler, Studio Completiva (commercial only)
Colorado Energy Office
Regional Air Quality Council
Jim Smith, Golden Real Estate
Environment Colorado
Francesca Wahl, Tesla
COPIRG

_______________________________________________________________

AMENDMENT PROPOSAL

Please use a separate form for each proposal.

1) Code(s) associated with this proposal. Please use acronym:

IECC, IRC

If you submitted a separate coordination change to another code, please indicate which code:

_______________________________________________________________

Acronym  Code Name                                      IBC          IEBC
DBC-xxxx Denver Building Code—xxxx (code) amendments (e.g., DBC-IBC, DBC-IEBC) International Existing Building Code
IECC International Energy Conservation Code
IGCC International Green Construction Code
Acronym Code Name
IFC International Fire Code
IMC International Mechanical Code
IFGC International Fuel Gas Code
IPC International Plumbing Code
IRC International Residential Code

2) Please check here if a separate graphic file is provided: ☐
   Graphics may also be embedded within your proposal below.

3) Use this template to submit your proposal or attach a separate file, but please include all items requested below in your proposal. The only formatting needed is BOLDING, STRIKEOUT AND UNDERLINING. Please do not provide additional formatting such as tabs, columns, etc., as this will be done by CPD.

<table>
<thead>
<tr>
<th>Code Sections/Tables/Figures Proposed for Revision:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PART I — IECC: C202, C405.10 (New), C405.10.1 (New), TABLE C405.10.1 (New), C405.10.2 (New), TABLE C405.10.2 (New), C405.10.3 (New), C405.10.4 (New)</td>
</tr>
<tr>
<td>PART II — IECC: R202 (IRC N1101.6), R404.2 (IRC N1104.2) (New), R404.2.1 (IRC N1104.2.1) (New), R404.2.2 (IRC N1104.2.2) (New), Table R404.2.2 (IRC N1104.2.2) (New), R404.2.3 (IRC N1104.2.3) (New), R404.2.4. (IRC N1104.2.4) (New)</td>
</tr>
<tr>
<td>PART III –IRC: R327</td>
</tr>
</tbody>
</table>

Note: If the proposal is for a new section, indicate (new).

Proposal:

Part 1. Add new text as follows:

2018 International Energy Conservation Code

CHAPTER 2: DEFINITIONS

SECTION C202 GENERAL DEFINITIONS:

Add the following definitions:

Electric Vehicle (EV): A vehicle registered for on-road use, primarily powered by an electric motor that draws current from a rechargeable storage source that is charged by being plugged into an electrical current source.

Electric Vehicle Supply Equipment (EVSE). The electrical conductors and associated equipment external to the electric vehicle that provide a connection between the premises wiring and the electric vehicle to provide electric vehicle charging.

Electric Vehicle Fast Charger. Electric vehicle supply equipment with a minimum power output of 20 kW.

Electric Vehicle Load Management System. A system designed to allocate charging capacity among multiple electric vehicle supply equipment at a minimum of 8 amps per charger.
Electric Vehicle Capable Space. A designated parking space that is provided with conduit sized for a 40-amp, 208/240-Volt dedicated branch circuit from a building electrical panelboard to the parking space and with sufficient physical space in the same building electrical panelboard to accommodate a 40-amp, dual-pole circuit breaker.

Electric Vehicle Ready Space. A parking space that is provided with one 40-amp, 208/240-Volt dedicated branch circuit for electric vehicle supply equipment that is terminated at a receptacle, junction box, or electric vehicle supply equipment within the parking space.

Electric vehicle supply equipment (EVSE) installed space. A parking space with electric vehicle supply equipment capable of supplying a 40-amp dedicated branch circuit rated at 208/240 Volt from a building electrical panelboard.

Level 3 Alteration: Alterations where the work area exceeds 50 percent of the original building area or more than 10 parking spaces are substantially modified.

CHAPTER 4: COMMERCIAL ENERGY EFFICIENCY

SECTION C405: ELECTRICAL POWER AND LIGHTING SYSTEMS

C405.10. Electric Vehicle (EV) charging for new construction and Level 3 Alterations
The building shall be provided with electric vehicle charging in accordance with this section and the National Electrical Code (NFPA 70). When parking spaces are added or modified without an increase in building size or a Level 3 Alteration, only the new parking spaces are subject to this requirement.

C405.10.1. Group R occupancies. Group-R occupancies with three or more dwelling units and/or sleeping units shall be provided with electric vehicle charging in accordance with Table C405.10.1. Calculations for the number of spaces shall be rounded up to the nearest whole number. All EVSE Installed, EV Ready and EV Capable Spaces are to be included in the calculation for the number of minimum vehicle spaces required, as provided by the applicable article of the Denver Zoning Code.

Table C405.10.1.

<table>
<thead>
<tr>
<th>Number of Spaces</th>
<th>Number of EV Ready Spaces</th>
<th>Number of EV Capable Spaces</th>
<th>Number of EVSE Installed Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 space</td>
<td>1</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2 to 9 spaces</td>
<td>1</td>
<td>20% of spaces</td>
<td>None</td>
</tr>
<tr>
<td>10 or more spaces</td>
<td>15% of spaces</td>
<td>Remainder of spaces</td>
<td>5% of spaces</td>
</tr>
</tbody>
</table>

C405.10.2 Group A, B, E, I, M and S-2 occupancies. Group A, B, E, I, M and open or enclosed parking garages under S-2 occupancy shall be provided with electric vehicle charging in accordance with Table C405.10.2. Calculations for the number of spaces shall be rounded up to the nearest whole number. All EVSE Installed, EV
Ready and EV Capable Spaces are to be included in the calculation for the number of minimum vehicle spaces required, as provided by the applicable article of the Denver Zoning Code.

Table C405.10.2.

<table>
<thead>
<tr>
<th>Number of EV Ready Spaces</th>
<th>Number of EV Capable Spaces</th>
<th>Number of EVSE Installed Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 space</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>2 to 9 spaces</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10 or more spaces</td>
<td>10% of spaces</td>
<td>10% of spaces</td>
</tr>
<tr>
<td></td>
<td>5% of spaces</td>
<td></td>
</tr>
</tbody>
</table>

Exception: The number of electric vehicle supply equipment installed spaces may be reduced by up to five provided that the building includes not less than one parking space equipped with an electric vehicle fast charger and not less than one electric vehicle ready space.

C405.10.3. Identification. Construction documents shall designate all electric vehicle capable spaces, electric vehicle ready spaces and electric vehicle supply equipment installed spaces and indicate the locations of conduit and termination points serving them. The circuit breakers or circuit breaker spaces reserved for the electric vehicle capable spaces, electric vehicle ready spaces, and electric vehicle supply equipment installed spaces shall be clearly identified in the panelboard directory. The conduit for electric vehicle capable spaces shall be clearly identified at both the panelboard and the termination point at the parking space.

C405.10.4. Accessible parking
Where new EVSE Installed Spaces and/or new EV Ready Spaces and new accessible parking are both provided, parking facilities shall be designed so that at least one accessible parking space shall be EV Ready or EVSE Installed.

Part 2. Add new text as follows:

2018 International Energy Conservation Code
SECTION R202 (IRC N1101.6) GENERAL DEFINITIONS

CHAPTER 2:
DEFINITIONS

SECTION R202 GENERAL DEFINITIONS:

Add the following definitions:

Electric Vehicle (EV): A vehicle registered for on-road use, primarily powered by an electric motor that draws current from a rechargeable storage source that is charged by being plugged into an electrical current source.

Electric Vehicle Supply Equipment (EVSE). The electrical conductors and associated equipment external to the electric vehicle that provide a connection between the premises wiring and the electric vehicle to provide electric vehicle charging.
**Electric Vehicle Load Management System.** A system designed to allocate charging capacity among multiple *electric vehicle supply equipment* at a minimum of 8 amps per charger.

**Electric Vehicle Capable Space.** A designated parking space that is provided with conduit sized for a 40-amp, 208/240-Volt dedicated branch circuit from a building electrical panelboard to the parking space and with sufficient physical space in the same *building* electrical panelboard to accommodate a 40-amp, dual-pole circuit breaker.

**Electric Vehicle Ready Space.** A parking space that is provided with one 40-amp, 208/240-Volt dedicated branch circuit for *electric vehicle supply equipment* that is terminated at a receptacle, junction box or *electric vehicle supply equipment within the parking space*.

**Electric vehicle supply equipment (EVSE) installed space.** A parking space with electric vehicle supply equipment capable of supplying a 40-amp, dedicated circuit rated at 208/240 Volt from a building electrical panelboard.

**Level 3 Alteration:** Alterations where the work area exceeds 50 percent of the original building area or more than 10 parking spaces are substantially modified.

*Townhomes – Dwelling units constructed in a group of three or more attached units in which each unit extends from foundation to roof and is not more than three (3) stories above grade plane.*

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**CHAPTER 4:**  
**RESIDENTIAL ENERGY EFFICIENCY:**

**SECTION R404: ELECTRICAL POWER AND LIGHTING SYSTEMS**

**R404.2. Electric Vehicle (EV) charging for new construction and Level 3 Alterations**  
The *building* shall be provided with *electric vehicle* charging in accordance with this section and the *National Electrical Code (NFPA 70).* When parking spaces are added or modified without an increase in building size or a Level 3 Alteration, only the new parking spaces are subject to this requirement.

*Exception: Alterations to single-family dwellings, two-family dwellings and townhomes shall not be required to comply with this section.*

**R404.2.1. One- to two-family dwellings and townhouses.**  
Each dwelling unit with a dedicated attached or detached garage, shall be provided with at least one *electric vehicle ready space.* The branch circuit shall be identified as “EV Ready” in the panelboard directory, and the termination location shall be marked as “EV Ready”.
R404.2.2. Group-R occupancies. Group-R occupancies with three or more dwelling units and/or sleeping units shall be provided with electric vehicle charging in accordance with Table R404.2.2. Calculations for the number of spaces shall be rounded up to the nearest whole number. All EVSE Installed, EV Ready and EV Capable Spaces are to be included in the calculation for the number of minimum vehicle spaces required, as provided by the applicable article of the Denver Zoning Code.

Table R404.2.2.

<table>
<thead>
<tr>
<th></th>
<th>Number of EV Ready Spaces</th>
<th>Number of EV Capable Spaces</th>
<th>Number of EVSE Installed Spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 space</td>
<td>1</td>
<td>None</td>
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<td>2 to 9 spaces</td>
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<td>Remainder of spaces</td>
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</tr>
</tbody>
</table>

R404.2.3. Identification.
Construction documents shall designate all electric vehicle capable spaces, electric vehicle ready spaces, and electric vehicle supply equipment installed spaces and indicate the locations of conduit and termination points serving them. The circuit breakers or circuit breaker spaces reserved for the electric vehicle capable spaces, electric vehicle ready spaces, and electric vehicle supply equipment installed spaces shall be clearly identified in the panelboard. The conduit for electric vehicle capable spaces shall be clearly identified at both the panelboard and the termination point at the parking space.

R404.2.4. Accessible parking
Where new EVSE Installed Spaces and/or new EV Ready Spaces and new accessible parking are both provided, parking facilities shall be designed so that at least one accessible parking space shall be EV Ready or EVSE Installed.

SECTION R327 ELECTRIC VEHICLE CHARGING

Section R327 Electric vehicle charging is added. R327.1 Electric vehicle charging. For new one- or two-family dwellings, each with a dedicated attached or detached garage, a minimum continuous load of 4800VA shall be included as part of the electrical service load calculations. This additional load shall be permitted to allow the inhabitant(s) the installation of a charging station for electric vehicles without the need of upgrading the electrical service of the dwelling. In addition to the spare power capacity, the premise’s electrical panel shall have at least two spare spaces for the installation of a 2-pole breaker for the charging station and conduit shall be routed from the electrical panel to the garage, unless wiring and receptacle for such use are installed.
Exception: Additions to existing one- or two-family dwellings and townhomes constructed per the IRC are exempt from this requirement.

Supporting Information:

Purpose: Add new requirements to the Code

Reason:
In Mayor Hancock’s 80 x 50 Climate Action Plan, Denver set the goal of reducing greenhouse gas (GHG) emissions 80% by 2050. The transportation sector is the second largest source of GHG emissions in Denver and the Climate Action Plan identifies electric vehicles as one of the key ways to reduce GHG coming from vehicles. One strategy identified in the Mayor’s plan to support vehicle electrification was to ‘create building codes to require charging opportunities at multifamily units and workplaces’. This amendment seeks to implement this strategy. To achieve these GHG reductions, Denver set a goal that by 2030 30% of vehicles would be electric, growing to 100% of vehicles in 2050 (Denver Department of Public Health and Environment).

To reach these ambitious goals, there will need to be significantly more charging stations available to Denver residents and drivers. The EVI-Pro tool developed by the Department of Energy, estimates that Denver would need to have nearly 10,000 publicly available stations in 2030 and 25,000 charging stations in 2050 to support the vehicle electrification goals (Alternative Fuels Data Center-1). Currently, in Denver there are approximately 350 publicly available charging stations so there is significant need for additional charging stations (Alternative Fuels Data Center-2).

Between 2015 and 2050, the state Demographer estimates that there will be 272,000 new people living in Denver, a 40% increase (Colorado Department of Local Affairs).

To serve all these new people and their associated jobs, the City’s stock of residential and commercial buildings will need to increase significantly. Making sure all these new buildings are equipped to charge electric vehicles will help increase EV adoption and save consumers and businesses a lot of money.

Because charging is most convenient where one is parked for long periods of time, it is important to make charging as easy as possible at residences.

In particular, there are significant logistical barriers for residents of multi-family dwellings to upgrade existing electrical infrastructure and install new EV charging stations. Installing charging stations at multi-family properties has proven challenging. With just under half (44%) of its population living in multi-family properties, this is an especially important area for Denver to concentrate on. While updating the building code will not directly address existing multi-family properties, it should encourage the overall market to move in this right direction as existing properties compete with new properties for customers.

Environmental and Public Health Benefits
In addition to reducing GHG emissions, electric vehicles also help to clean up Denver’s air and improve public health by reducing harmful tailpipe emissions compared to gasoline vehicles. The table below shows the
reduction in emissions for GHG and NOx and VOC, the two tailpipe pollutants that are precursors to ground level ozone.

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2026</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG</td>
<td>34%</td>
<td>59%</td>
</tr>
<tr>
<td>NOx</td>
<td>71%</td>
<td>83%</td>
</tr>
<tr>
<td>VOC</td>
<td>99%</td>
<td>99%</td>
</tr>
</tbody>
</table>

EVs provide significant economic benefits for consumers through fuel and maintenance cost savings.

Additional Information
Electric vehicles sales are growing strongly in Colorado, indicating there will be demand for additional stations. In 2018, electric vehicles made up 2.6% of vehicles sales in Colorado and in December of 2018, electric vehicles sales made up 5.36% of vehicles sales in the state. In Colorado, electric vehicle (EV) sales increased by 70 percent from 2017 to 2018 (Auto Alliance).

Data from the Regional Air Quality Council on a subset of existing charging stations in Denver has shown significant growth in usage over the last five years. Between 2014 and 2019, average monthly electricity consumption at charging stations increase from 112 kWh to 318 kWh, an increase of 184%. This increase occurred even as the number of stations increased from nine to 101 over the same period of time.

Due to their lower fueling and maintenance costs, electric vehicles can provide a substantial economic benefit to lower income populations, if they have access to charging stations. Lower income households spend twice as much of their income on transportation compared to higher income households (Pew) and would benefit the most from access to charging. Without these requirements it will be even more unlikely that property owners and landlords will support the installation of charging stations at lower income properties.

Bibliography
Denver Department of Public Health and Environment. 80 x 50 Climate Action Plan. https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/80x50/DDPHE_80x50_ClimateActionPlan.pdf


**Referenced Standards:**

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

**Impact:**

**Cost Impact:**
A lack of pre-existing EV charging infrastructure, such as electrical panel capacity, raceways, and pre-wiring, can make the installation of a new charging station cost-prohibitive for a potential EV-owner or station site host. The installation of an EV charging station is made three to four times less expensive when the infrastructure is installed during the initial construction phase as opposed to retrofitting existing buildings to accommodate the new electrical equipment. These additional retrofit costs typically include labor expenses for demolition, trenching and boring, balancing the circuits, and new permitting costs.

New residential and commercial buildings are constructed to last for decades, and so it is critical that EV charging infrastructure is incorporated at the pre-construction stage to ensure that new buildings can accommodate the charging needs of future EV-owners.

The code change proposal will increase the cost of initial construction, but provide long-term savings for EV owners and charging station hosts through the avoided retrofit costs of installing EV charging infrastructure.

**One- and two-family dwellings:** The additional costs should be minimal as the current code already requires panel capacity and conduit. They would involve the installation of one 40-ampere, 208/240-volt dedicated branch circuit and a circuit terminating in a receptacle, junction box, or EVSE.

**Multi-family residential and commercial:**
The cost of making a parking space EV Capable during new construction is estimated at $300 per space. The cost of retrofitting a parking space to be EV Capable is estimated at $2,500. The cost of making a parking space EV Ready during new construction is estimate at $1,300 per space. The cost of retrofitting a parking space to be EV Ready is estimated at $6,300. (Energy Solutions).

For a new multi-family building with 50 parking spaces, this code amendment is estimated to add $34,100 to the total new construction cost. If the same infrastructure upgrades were made during a later retrofit of the building they are estimated to cost $187,400.
For a new commercial building with 100 parking spaces, this code amendment is estimated to add $36,000 to the total new construction cost. If the same infrastructure upgrades were made during a later retrofit of the building they are estimated to cost $108,000.

Data from the Regional Air Quality Council shows that the cost of installing the station (which includes retrofit costs) is almost twice as much as the cost of the station itself. The average cost of stations which have received grants from the RAQC is $11,690, while the average installation and construction costs have been $20,440 per site.

The overall impact on building costs is low. An analysis done by the California Air Resources Board in 2018, examined the costs of adding EV Ready requirements for new multi-family developments. It found that adding panel capacity and conduit during new construction would add between 0.1% and 0.2% to the total building cost for 1,500 square foot units (California Air Resources Board).

**Note:** Discuss the impact of this proposal in this section AND indicate the impact of this amendment proposal for each of the following:

- The effect of the proposal on the cost of construction: ☒ Increase ☐ Reduce ☐ No Effect
- The effect of the proposal on the cost of design: ☒ Increase ☐ Reduce ☐ No Effect
- Is the proposal more or less restrictive than the I-codes: ☐ More ☐ Less ☒ Same

**Departmental Impact:** (To be filled out by CPD staff)

**Note:** CITY STAFF ONLY. Discuss the impact of this proposal in this section AND indicate the impact of this amendment proposal for each of the following:

- The effect of the proposal on the cost of review: ☐ Increase ☐ Reduce ☐ No Effect
- The effect of the proposal on the cost of enforcement/inspection: ☐ Increase ☐ Reduce ☐ No Effect
- The effect of the proposal on the cost of enforcement/inspection: ☐ Increase ☐ Reduce ☐ No Effect