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.

Denver Green Code Building Grid Flexible Water Heating Proposal

Code Sections/Tables/Figures Proposed for Revision:
Instructions: If the proposal is for a new section, indicate (new), otherwise enter applicable code section.**403**

Add new definitions as follows:

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*.

Add new section as follows:

403.1 Demand Responsive Water Heating. Electric storage water heaters with rated water storage volume between 40 and 120 gallons and a nameplate input rating equal to or less than 12kW shall have *demand responsive controls* that comply with ANSI/CTA-2045-B Level 2 or equivalent *approved* standard.

Exceptions:

1. Water heaters that provide a hot water delivery temperature of 180°F (82°C) or greater
2. Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code

3. Water heaters that use 3-phase electric power
4. Storage water heaters with *demand response controls* that comply with ANSI/CTA-2045-A or ANSI/CTA-2045-B Level 1, that are also capable of initiating water heating to meet the temperature set point in response to a *demand response signal.*

Modify the table as follows:

TABLE R401.4
REQUIREMENTS FOR ENERGY RATING INDEX

SECTION	TITLE
Mechanical	
R403.5.5	Demand responsive water heating

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 requires that all storage tank water heaters installed in residential buildings using the Denver Green Code are compatible with the ANSI/CTA-2045-B grid flexibility protocol.

- Reason: Why is your proposal necessary?

This proposal requires that electric water heaters with integrated storage tanks installed in homes using the Denver Green Code have grid flexible controls, a kind of advanced demand control functionality. This functionality allows water heaters to "float" during periods of high demand and resume heating water after the high demand period is over or when water temperatures in the tank drop to the lower limit of acceptable temperature. ANSI/CTA-2045 is the industry standard for grid-flexible controls for water heaters, but the requirement allows for other protocols to be approved by the building official. The requirement is limited to electric water heaters with integrated storage tanks. It also only applies to water heaters over 40 gallons in order to exclude small, point-of-use water heaters.

The proposal also adds an additional line to Table R406.2, ensuring that this requirement is included in the ERI approach.

Demand control functionality will also present a cost-saving opportunity for buildings in the future. XCEL currently offers an optional demand response program. However, more and more utilities are moving beyond voluntary programs and are expanding use of time-of-use rates for electricity as a tool for shaping demand. Installing demand-responsive water heating controls now will allow residential tenants to better control their utility costs in the future.

Since this requirement is part of the construction code, it will not require buildings to participate in any demand response programs. But it will ensure that buildings are capable of participating, so that Denver buildings will be able to help integrate building loads with available production.

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

Why grid-flexible controls are important:

Grid flexibility is one of the four foundations of "Denver's Net Zero Energy (NZE) New Buildings & Homes Implementation Plan." Grid flexibility is an essential element of decarbonizing the electrical grid. Carbon free energy sources like solar and wind have varying production over the course of the day and the year. Demand responsive controls that can respond to demand response signals enable buildings to shape their loads to better align with available energy production. This could come in the form of curtailing energy use when demand is high or utilizing excess production for building tasks like pre-conditioning spaces or service hot water when demand is lower.

Water heating is one of the largest single loads in residences. Storage tanks can effectively act as "batteries," storing grid energy. These two facts make residential water heaters one of the more significant opportunities for providing the grid with load shaping opportunities. More-efficient systems such as heat pump water heaters save intrinsically, but the time during which energy is consumed is quickly becoming more important in many utility territories around the country. The savings from grid-flexible controls on water heaters are driven by how those controls may be used to modify the time of energy demand, both through enabling preheating ("Basic Load Up" and "Advanced Load Up" in the language from California Energy Code Title 24 Joint Appendix 13) and through load

shedding options (Joint Appendix 13 describes "Light Shed," "Deep Shed," and "Full Shed" to describe multiple modalities involving electric resistance and compressor deferral during demand response or similar events). As utilities such as XCEL meet carbon reduction goals through transitioning energy sources to more time-dependent low-carbon sources like solar and wind, managing time of use is becoming more critical.

Not only will this measure result in cost savings to consumers, it will also result in other significant societal benefits. According to DOE's report, "A National Roadmap for Grid-Interactive Efficient Buildings", every watt in peak demand savings was found to create 17 cents in annual electric grid system value. This value included energy savings, capacity savings, transmission deferral and ancillary services. A single-family home with a grid-integrated water heater is estimated to reduce peak demand savings by 0.3kW which would result in $51 in annual electric grid system value. Grid-integrated water heaters allow grid operators to reduce demand on the grid during the times when the carbon intensity of the electric grid is high, which also results in reduced carbon emissions – generating additional significant societal benefits.

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

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.

Referenced Standards:

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

Impact:

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

Cost:

CTA-2045 controls are emerging as a standard feature of many heat pump water heaters. Models from Rheem currently have them and AO Smith models are expected this year. CTA-2045 models are sometimes less expensive than non-CTA-2045 models. As it will be difficult to meet the performance requirements of Denver's energy code with electric water heaters that are not Heat Pump models, the incremental cost of this requirement is effectively nothing.

As time-of-use rates and demand response or similar programs become more widespread and of higher magnitude, the customer cost savings associated with demand flexibility ability will grow substantially. For example, the New York utility ConEdison has a Residential Time of Use Rate whose summertime peak rate is $0.2384/kWh and whose summertime offpeak rate is $0.0168/kWh – a value differential of more than 14x. In winter the peak-time rate is $0.0882/kWh, but the offpeak rate remains the same – a value differential of 5x. Water heaters able to shift load can empower customers to take advantage of these cost differentials to deliver substantial savings.

Cost of construction:	___ Increase	_X__ Decrease	___ No Impact
Cost of design:	___ Increase	__X_ Decrease	__X_ 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.