International Energy Conservation Code
E4C-HVACR Subcommittee

Meeting Agenda

March 23, 2023
11:00 AM EST to 2:00 PM EST
Webex Link

Committee Chair: John Bade, representing the California Investor Owned Utilities
Committee Vice Chair: Blake Shelide, Oregon Department of Energy

1. **Call to order**-Chair or vice-chair

2**. Meeting Conduct**. Staff
   a. Identification of Representation/Conflict of Interest
   b. ICC Council Policy 7 Committees: Section 5.1.10 Representation of Interests
   c. ICC Code of Ethics: ICC advocates commitment to a standard of professional behavior that exemplifies the highest ideals and principles of ethical conduct which include integrity, honesty, and fairness. As part of this commitment, it is expected that participants shall act with courtesy, competence and respect for others.

3. **Roll Call** – Establish Quorum- John Bade

	First Name	Last Name	Category	Company
☐	John	Bade	Utility	2050 Partners
☐	Drake	Erbe	Standards Promulgator	ASHRAE
☐	Henry	Ernst	Manufacturer	Daiken
☐	Mark	Heizer	Gov. Regulator	Oregon Bldg Codes Div
☐	Gary	Klein	User	Self
☐	Jeff	Kleiss	Manufacturer	Lochinvar (AO Smith)
☐	Benjamin	Levie	Consumer	UCSF
☐	Dick	Lord	Manufacturer	Carrier
☐	Frank	Morrison	Manufacturer	Baltimore Aircoil
☐	Christopher	Perry	Gov. Regulator	US DOE
☐	Daniel	Nall	Gov. Regulator	Dan Nall Consultant/ AIA
☐	Laura	Petrillo-Groh	Manufacturer	AHRI
☐	Kevin	Rose	Public Segment	NEEA
☐	Shannon	Corcoran	Utility	American Gas Assoc.
☐	Blake	Shelide	Gov. Regulator	Oregon Dept of Energy
☐	Amin	Tohmaz	Gov. Regulator	City of San Antonio
☐	Doug	Tucker	Manufacturer	Mitsubishi
☐	Jeremy	Williams	Gov. Regulator	US DOE
☐	James	Yeoman	Gov. Regulator	City of Orem

4. **Review of Notes** from the March 9, 2023 meeting . Per staff direction, subcommittees do not have minutes, but notes. These do not need a vote.

5. **Approval of Agenda**

6. **Old Business** - none

7. **Review and possibly vote on the following public comments**

Proposal Number	Code Section(s)	description	proponent	Subcommittee Member Lead
CED1-156-22	C403.3.2	Update efficiency tables to match ASHRAE 90.1	Steven Rosenstock	John Bade
CECD1-XX-22	Table C404.2	Footnote for large storage water heaters	Bryan Ahee	John Bade
CED1-15-22	New Appendix	All-Electric Buildings Option	Diana Burke	TBD
CED1-14-22	Multiple	Electric-Ready Requirements for Building Employing Combustion Fuels	Diana Burke	TBD

Working with IE

8. **Updates on other public comments**. Reports from subcommittee response leads on progress working with commenters.

9. **Other business**.
- Members to bring up any new business

10. **Upcoming meetings**.
a. April 6, 2023, from 11:00 a.m. to 2:00 p.m. Eastern Time (if necessary) and every two weeks thereafter.,

11. **Adjourn**.

FOR FURTHER INFORMATION BE SURE TO VISIT THE ICC WEBSITE:
ICC Energy webpage
Code Change Monograph

FOR ADDITIONAL INFORMATION, PLEASE CONTACT EITHER

- John Bade, Subcommittee Chair at johnbade@2050partners.com.
- Blake Shelide, Subcommittee Vice-Chair at blake.shelide@energy.oregon.gov

CECD1-XX-22 Efficiency Table Footnote for Large Water Heaters

Proponents: Bryan Ahee (bahee@bradfordwhite.com)

Revise as follows:

NOTE: Only lines that will change are shown

TABLE C404.2
MINIMUM PERFORMANCE OF WATER-HEATING EQUIPMENT

EQUIPMENT TYPE	SIZE CATEGORY	SIZE CATEGORY OR RATING CONDITION	DRAW PATTERN	PERFORMANCE REQUIRED	TEST
Electric Storage water heaters [e,f,l]	> 12 kW	-	-	(0.3 + 27/Vm), %h	DOE 10 CFR431.106 App B
Gas Storage water heaters[e,l]	> 105,000 Btu/hr	-	-	80% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Oil Storage water heaters[e,l]	**> 140,000 Btu/hr**	**All**	-	80% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Oil Instantaneous water heaters[h,l]	> 210,000 Btu/hr	≥ 10 gal	-	78% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Hot water supply boilers, gas[i,l]	≥300,000 Btu/h and <12,500,000 Btu/h	≥ 10 gal	-	80% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106
Hot water supply boilers, oil[h,l]	≥300,000 Btu/h and <12,500,000 Btu/h	≥ 10 gal	-	78% Et SL ≤ (Q/800 +110√V), Btu/h	DOE 10 CFR 431.106

…

l. Water heaters and hot water supply boilers having more than 140 gallons of storage capacity need not meet the standby loss requirement if: (1) The tank surface area is thermally insulated to R-12.5 or more; (2) a standing pilot light is not used; and (3) for gas or oil-fired storage water heaters, they have a fire damper or fan-assisted combustion.

CED1-14-22 Electric Ready Proposal

Add new text as follows:

C103.2.2 Electrification system. The construction documents shall provide details for additional electric infrastructure, including branch circuits, conduit, pre-wiring, panel capacity, and electrical service capacity, as well as interior and exterior spaces designated for future electric equipment, in compliance with the provisions of this code.

Revise text as follows:

C105.2.5 Electrical system. Inspection shall verify lighting system controls, components, ~~and~~ meters, and additional electric infrastructure as required by the code, approved plans and specifications.

Add new definitions as follows:

~~**ALL-ELECTRIC BUILDING.** A *building* that contains no *combustion equipment*, or plumbing for *combustion equipment*, installed within the *building* or *building site*.~~

APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements.

COMBUSTION EQUIPMENT. Any equipment or *appliance* used for space heating, *service water heating*, cooking, clothes drying and/or lighting that uses *fuel gas* or *fuel oil*.

COMMERCIAL COOKING APPLIANCES. ~~Appliances~~*Appliances* used in a commercial food service establishment for heating or cooking food and which produce grease vapors, steam, fumes, smoke or odors that are required to be removed through a local exhaust ventilation system. Such appliances include deep fat fryers, upright broilers, griddles, broilers, steam-jacketed kettles, hot-top ranges, under-fired broilers (charbroilers), ovens, barbecues, rotisseries, and similar appliances. For the purpose of this definition, a food service establishment shall include any building or a portion thereof used for the preparation and serving of food.

FUEL GAS. A natural gas, manufactured gas, liquified petroleum gas or a mixture of these.

FUEL OIL. Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).

Revise text as follows:

C405.5.3 Fuel Gas lighting. *Fuel gas*-fired lighting ~~appliances~~*appliances* shall not be ~~equipped with continuously burning pilot ignition systems~~ permitted.

Add new text as follows:

C403.15 Hydronic Heating Design Requirements. For all hydronic space heating systems, the design entering water temperature for coils, radiant panels, radiant floor systems, radiators, baseboard heaters, and any other device that uses hot water to provide heat to a space shall be not more than 130°F (55°C).

Add new text as follows:

C405.17 Additional electric infrastructure. Buildings that contain *combustion equipment* shall be required to install electric infrastructure in accordance with this section.

C405.17.1 Combustion space heating. Spaces containing *combustion equipment* for space heating shall comply with Sections C405.17.1.1, C405.17.1.2 and C405.17.1.3.

C405.17.1.1 Designated exterior locations for future electric space heating equipment. Spaces containing *combustion equipment* for space heating shall be provided with designated exterior location(s) shown on the plans and of sufficient size for outdoor space heating heat pump equipment, with a chase that is sized to accommodate refrigerant lines between the exterior location and the interior location of the space heating equipment, and with natural drainage for condensate from heating operation or a condensate drain located within 3 feet (914 mm) of the location of the future exterior space heating heat pump equipment.

C405.17.1.2 Dedicated branch circuits for future electric space heating equipment.

Spaces containing combustion space heating equipment with a capacity not more than 65,000 Btu/h shall be provided with a dedicated 240-volt, branch circuit with ampacity of not less than 50 and in compliance with NFPA 70 Section 422.10. The branch circuit shall terminate within 6 feet (1829 mm) of the space heating equipment and be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words "For Future Electric Space Heating Equipment" and be electrically isolated.

Spaces containing *combustion equipment* for space heating with a capacity of not less than 65,000 Btu/h shall be provided with a dedicated branch circuit rated and sized in accordance with Section C405.17.1.3, in compliance with NFPA70 Section 424.4, and terminating in a junction box within 3 feet (914 mm) of the location the space heating equipment without obstructions. Both ends of the branch circuit shall be labeled "For Future Electric Space Heating Equipment."

Exceptions:

1. Where a branch circuit provides electricity to the space heating *combustion equipment* and is rated and sized in accordance with Section C405.17.1.3
2. Where a branch circuit provides electricity to space cooling equipment and is ~~both~~ in compliance with NFPA70 Sections 440.4(B) and 440.35 and is rated and sized in accordance with Section C405.17.1.3.
3. Where future electric space heating equipment would require three-phase power and the space containing *combustion equipment* for space heating is provided with an electrical panel with a label stating, "For Future Electric Space Heating Equipment" and with a bus bar rated and sized in accordance with Section C405.17.1.3.
4. Buildings where the 99.6 percent design heating temperature is not less than 50°F (10°C)

C405.17.1.3 Additional space heating electric infrastructure sizing. Electric infrastructure for future electric space heating equipment shall be sized to accommodate at least one of the following:

1. An electrical capacity not less than the nameplate space heating *combustion equipment* heating capacity multiplied by the value in Table C405.17.1~~(1)~~ as shown in equation below ~~based on the climate zone and building occupancy group served by the space heating equipment. Where the space heating equipment serves multiple occupancies, the values in Table C405.17.1(1) shall be weighted by the gross floor area of each occupancy served by the space heating equipment and multiplied by the space heating *combustion equipment* heating capacity~~, or

$$VA_s = Q_{com} \cdot P_s$$

Where:

VA_s = The required electrical capacity of the electrical infrastructure in volt-amps

Q_{com} = The nameplate heating capacity of the combustion equipment in kBtu/h

P_s = The VA per kBtu/h from Table C405.17 in VA/kBtu/h

2. An electrical capacity not less than the peak space heating load of the building areas served by the space heating *combustion equipment*, calculated in accordance with Section C403.1.1, multiplied by the value for the 99.6 percent design heating temperature in Table C405.17.1~~(2) based on the climate zone and building occupancy group served by the space heating equipment. Where the space heating equipment serves multiple occupancies, the values in Table C405.17.1(2) shall be weighted by the gross floor area of each occupancy served by the space heating equipment and multiplied by the peak space heating load of the building areas served by the space heating equipment~~ per the equation below, or

$$VA_s = Q_{design} \cdot P_s$$

Where:

VA_s = The required electrical capacity of the electrical infrastructure in volt-amps

Q_{design} = The 99.6 percent design heating load of the spaces served by the *combustion equipment* in kBtu/h

P_s = The VA per kBtu/h from Table C405.17.1 in VA/kBtu/h

3. An alternate design that complies with this code, that is approved by the authority having jurisdiction, and that uses no energy source other than electricity or *on-site renewable energy*.

Table C405.17.1~~(1)~~ ALTERNATE ELECTRIC SPACE HEATING EQUIPMENT CONVERSION FACTORS (VA/kBtu/h) ~~– CAPACITY BASIS~~

99.6% Heating Design Temperature		P_s
Greater Than	Not Greater Than	VA/kBtu/h
50	N/A	N/A
45	50	94
40	45	100
35	40	107
30	35	115
25	30	124
20	25	135
15	20	149
10	15	164
5	10	184
0	5	210
-5	0	243
-10	-5	289
-15	-10	293

~~Building Occupancy Group~~	~~Climate Zone~~

	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1																			
I-2																			
R-1																			
B																			
A-2																			
M																			
E																			
S-1 and S-2																			
All Other																			

Table C405.17.1(2) ALTERNATE ELECTRIC SPACE HEATING EQUIPMENT CONVERSION FACTORS (VA/kBtu/h) – LOAD BASIS

Building Occupancy Group	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
R-2, R-4, and I-1																			
I-2																			
R-1																			
B																			
A-2																			

~~M~~																		
~~E~~																		
~~S-1 and S-2~~																		
~~All Other~~																		

C405.17.2 Combustion water heating. Spaces containing *combustion equipment* for water heating shall comply with Sections C405.17.2.1, C405.17.2.2 and C405.17.2.3.

C405.17.2.1 For each piece of combustion equipment for water heating with an input capacity of not more than 75,000 Btu/h, the following electrical infrastructure is required.

1. An individual 240-volt branch circuit with an ampacity of not less than 30 shall be provided and terminate within 6 ft (2 m) of the water heater and shall be in a location with *ready access*.

2. The branch circuit overcurrent protection device and the termination of the branch circuit shall be labeled "For future electric water heater".

3. The space for containing the future water heater shall have a height of not less than 7 ft (2 m), a width of not less than 3 ft (1 m), a depth of not less than 3ft (1 m) and with a volume of not less than 700 ft3 (20 m3).

Exception to C405.17.2.1: Where the space containing the water heater is provides for air circulation sufficient for the operation of a heat pump water heater, the minimum room volume shall not be required.

C405.17.2.~~2~~1 Designated locations for future ~~electric~~heat pump water heating equipment. Spaces containing *combustion equipment* with a capacity of greater than 75,000 Btu/h for water heating shall be provided with one of the following:

1. An interior location with a minimum volume the greater of 700 cubic feet (2000 L) or 7 cubic feet (200 L) per 1,000 Btu/h *combustion equipment* water heating capacity.
2. An interior location with sufficient airflow to exhaust cool air from future water heating heat pump equipment provided by no less than one 16-inch (406 mm) by 24-inch (610 mm) grill to a heated space and one 8-inch (203 mm) duct of no more than 10 feet (3048 mm) in length for cool exhaust air.

Spaces containing *combustion equipment* for water heating shall be provided with a condensate drain located within 3 feet (914 mm) of the location of the water heating equipment. The condensate drain shall maintain a minimum horizontal slope in the direction of discharge of not less than one-half unit vertical in 12 units horizontal (4-percent slope) and include a “P” trap or vent “t”.

C405.17.2.~~3~~2 Dedicated branch circuits for future electric water heating equipment. Spaces containing *combustion equipment* for water heating with a capacity of greater than 75,000 Btu/h shall be provided with a dedicated branch circuit rated and sized in accordance with Section C405.17.2.3, in compliance

with NFPA70 Section 424.4 and terminating in a junction box within 3 feet (914 mm) of the location the water heating equipment without obstructions. Both ends of the branch circuit shall be labeled "For Future Electric Water Heating Equipment."

Exception: Where future electric water heating equipment would require three-phase power and the main electrical service panel has a reserved space for a bus bar rated and sized in accordance with Section C405.17.2.3 and labeled "For Future Electric Water Heating Equipment."

C405.17.2.~~3~~4 Additional water heating electric infrastructure sizing. Electric infrastructure water heating equipment with a capacity of greater than 75,000 Btu/h shall be sized to accommodate one of the following:

~~1.~~ An electrical capacity not less than the *combustion equipment* water heating capacity multiplied by the value in Table C405.17.2 plus electrical capacity to serve recirculating loads as shown in the equation below. ~~based on the climate zone and building occupancy group served by the water heating equipment. Where the water heating equipment serves multiple occupancies, the values in Table C405.17.2 shall be weighted by the gross floor area of each occupancy served by the water heating equipment and multiplied by the *combustion equipment* water heating capacity, or~~

$$VA_w = \left(Q_{capacity} \cdot P_w\right) + \left(Q_{recirc} \cdot 293 \frac{VA}{Btu/h}\right)$$

Where:

VA_w = The required electrical capacity of the electrical infrastructure for water heating in volt-amps

$Q_{capacity}$ = The water heating capacity of the *combustion equipment* in kBtu/h

Pw = The VA per kBtu/h from Table C405.17.2 in VA/kBtu/h

Q_{recirc} = The capacity required for temperature maintenance by recirculation, if applicable, in Btu/h

2. An alternate design that complies with this code, that is approved by the authority having jurisdiction, and that uses no energy source other than electricity or *on-site renewable energy*.

Table C405.17.2 ALTERNATE ELECTRIC WATER HEATING EQUIPMENT CONVERSION FACTORS (VA/kBtu/h)

99.6% Heating Design Temperature		P_w
Greater Than	Not More Than	VA/kBtu/h
55	60	118
50	55	123
45	50	129
40	45	136
35	40	144
30	35	152
25	30	162
20	25	173

15	20	185
10	15	293
5	10	293
0	5	293
Less than 0 °F (-17.8°C)		293

~~Building Occupancy Group~~	~~Climate Zone~~																			
	~~0A~~	~~0B~~	~~1A~~	~~1B~~	~~2A~~	~~2B~~	~~3A~~	~~3B~~	~~3C~~	~~4A~~	~~4B~~	~~4C~~	~~5A~~	~~5B~~	~~5C~~	~~6A~~	~~6B~~	~~7~~	~~8~~
~~R-2, R-4, and I-1~~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
~~I-2~~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
~~R-1~~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
~~B~~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
~~A-2~~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
~~M~~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
~~E~~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
~~S-1 and S-2~~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
~~All Other~~	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

C405.17.3 Combustion cooking. Spaces containing combustion equipment for cooking shall comply with either C405.17.3.1 or C405.17.3.2

C405.17.3.1 Commercial cooking. Spaces containing *commercial cooking* ~~appliances~~*appliances* shall be provided with a dedicated branch circuit with a minimum electrical ~~ca~~ampacit in accordance with Table 405.17.3.1 based on the ~~appliance~~*appliance* in the space. The branch circuit shall terminate within 3 feet (914 mm) of the ~~appliance~~*appliance* with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future Electric Cooking Equipment” and be electrically isolated.

Table 405.17.3.1 COMMERCIAL COOKING MINIMUM BRANCH CIRCUIT ~~C~~AMPACITY

Commercial Cooking ~~Appliance~~*Appliance*	Minimum Branch Circuit ~~Ca~~Ampacity
Range	114 VA/kBtu/h
Steamer	469 VA/kBtu/h

Fryer	200 VA/kBtu/h
Oven	266 VA/kBtu/h
Griddle	195 VA/kBtu/h
All other commercial cooking ~~appliances~~*appliances*	114 VA/kBtu/h

C405.17.3.2 All other cooking. Spaces containing all other cooking equipment not designated as *commercial cooking appliances* shall be provided with a dedicated branch circuit in compliance with NFPA 70 Section 422.10. The branch circuit shall terminate within 6 feet (1829 mm) of fossil fuel ranges, cooktops and ovens and be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words "For Future Electric Cooking Equipment" and be electrically isolated.

C405.17.4 Combustion clothes drying. Spaces containing combustion equipment for clothes drying shall comply with either C405.17.4.1 or C405.17.4.2

C405.17.4.1 Commercial drying. Spaces containing clothes drying equipment, and end-uses for commercial laundry applications shall be provided with conduit that is continuous between a junction box located within 3 feet (914 mm) of the equipment and an electrical panel. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient ~~c~~ampacity for an equivalent electric equipment with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, "For Future Electric Clothes Drying Equipment."

C405.17.4.2 Residential drying. Spaces containing clothes drying equipment, ~~appliances~~*appliances s,* and end-uses serving multiple *dwelling units* or sleeping areas with a ~~c~~ampacity less than or equal to 9.2 cubic feet shall be provided with a dedicated 240-volt branch circuit with a minimum ~~c~~ampacity of 30 ~~amps~~ and shall terminate within 6 feet (1829 mm) of fossil fuel clothes dryers and shall be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words "For Future Electric Clothes Drying Equipment" and be electrically isolated.

Reason Statement:

In order for the U.S. to reach net zero carbon emissions, the country must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also begin to transition away from using combustion equipment in buildings that run on fossil fuels to electric equipment. In 2021, combustion equipment in commercial and residential buildings accounted for 35% of US greenhouse gas emissions.[1] The cost of installing electric-ready infrastructure when a building is under construction, walls are open, and the trades are already on-site, is small in

comparison to the cost of retrofitting a building to install the same level of electric equipment. Having electric-ready infrastructure in place gives building owners or occupants the choice to shift to electric appliances at time of replacement or retrofit without incurring the costs and delays of retrofitting panels, opening walls to install conduit, etc. The residential 2024 IECC has included mandatory electric-ready requirements for water heating, cooktops and clothes drying into the public comment review draft #1. The California Building Energy Efficiency Standards 2022 update (Title 24, Part 6) has also moved in this direction, including electric-ready requirements for heat pump space heating, cooktops and clothes drying in both single family homes and multifamily buildings, and for water heating in single family homes. The Chicago Energy Transformation Code has also included electric-ready requirements for residential single family and multifamily buildings in their energy code. Attached is a letter with others stating the support for this proposal from 50 organizations, 16 of which are from local or state governments and universities, 12 of which are from NGOs, and 22 of which are from design and construction industry. In addition to the letter of support, this proposal includes more than 30 co-proponents.

Requiring buildings to be electric-ready will not only reduce costs for building owners who choose to electrify their building at a later date but it will also give building residents the option to improve their own health. Gas appliances release harmful pollutants like nitrogen dioxide (NO2) and carbon monoxide (CO) either indoors because of gas stoves or outdoors because of space-heating and water heating equipment. A recent study from the Harvard Chang School of Public Health and RMI shows that in Illinois in 2017, air pollution from burning fuels in buildings led to an estimated 1,123 early deaths and $12.574 billion in health impact costs.[2] These emissions can particularly affect children. In a meta-analysis analyzing the connections between gas stoves and childhood asthma, children in homes with gas stoves were 42% more likely to experience asthma symptoms, and 32% more likely to be diagnosed with asthma. [3] Therefore, ensuring all-electric appliances can be installed in our buildings in the future is critical to reducing air pollution, protecting public health, reducing utility and construction costs, and meeting climate goals.

NBI, ACEEE, and 2050 Partners on behalf of the California Investor Owned Utilities worked together to address many of the technical concerns raised when NBI's original proposal, CEPI-22, was discussed by the Commercial Consensus Committee in June of 2022. The main revisions to this proposal include:

1. Separating the original CEPI-22 proposal into three pieces, an electric-ready proposal, an all-electric appendix, and a requirement for more energy efficiency credits in buildings that do not primarily use heat pumps for space and water heating. Each piece stands alone with its own independent support, so each proposal can be discussed and voted on separately.
2. Requiring buildings with central water heating or space heating systems to have the electrical capacity but not conduit for a new system to ensure that unnecessary conduit is not placed in buildings that choose to install distributed and not central systems at a future date.
3. Clear electrical capacity requirements for electric-ready space and water heating based on occupancy type and climate zone to ensure that there is sufficient capacity to install efficient heat pumps for space heating and water heating without requiring full design and sizing of an all-electric alternative to a fuel-based system (though that option remains for flexibility). 2050 Partners is conducting energy modeling to determine capacity requirements. This modeling is not yet complete but will be complete before this proposal is considered by the commercial consensus committee.
4. Clear capacity requirements for commercial cooking appliances based on research conducted by NBI on the minimum branch circuits needed for a variety of commercial cooking appliances.
5. Additional flexibility that allows designers to submit an alternate design for the electrical infrastructure needed for water and space heating that would allow the building to use no energy source other than electricity or on-site renewable energy in the future.
6. Restructuring of the proposal to make it easier to understand and enforce.

Bibliography:

[1] “U.S. Energy Information Administration - EIA - Independent Statistics and Analysis.” *Energy and the Environment Explained: Where Greenhouse Gases Come From*, U.S. Energy Information Administration (EIA), https://www.eia.gov/energyexplained/energy-and-the-environment/where-greenhouse-gases-come-from.php#:~:text=In%202021%2C%20petroleum%20accounted%20for,energy%2Drelated%20CO2%20emissions.

[2] *Health Air Quality Impacts of Buildings Emissions*. RMI, 5 May 2021, rmi.org/health-air-quality-impacts-of-buildings-emissions#MI.

[3] *Gas Stoves: Health and Air Quality Impacts and Solutions.* RMI, 1 Feb. 2021, rmi.org/insight/gas-stoves-pollution-health/.

[4]*Cost Study of the Building Decarbonization Code* , New Buildings Institute, Apr. 2022, https://newbuildings.org/wp-content/uploads/2022/04/BuildingDecarbCostStudy.pdf.

[5] *2021 Reach Code Cost-Effectiveness Analysis: Non-Residential Alterations*, California Energy Codes and Standards, 27 Jan. 2022, https://localenergycodes.com/.

CED1-15-22

Proponents: Diana Burk, representing New Buildings Institute (diana@newbuildings.org); Michael Waite, representing American Council for an Energy-Efficient Economy (mwaite@aceee.org); John Bade, representing California Investor Owned Utilities (johnbade@2050partners.com); Rachael Dorothy, representing self (dorothy.2@osu.edu); Erin Sherman, representing RMI (esherman@rmi.org); Melissa Kops, representing CT Green Building Council (melissa@ctgbc.org); Andy Woommavovah, representing Healthcare (andy.woommavovah@trinity-health.org); Jenny Hernandez, representing Las Cruces Sustainability (jehernandez@las-cruces.org); Khaled Mansy, representing self (khaled.mansy@okstate.edu); Brad Smith, representing City of Fort Collins (brsmith@fcgov.com); Brad Hill, representing Honeywell International Inc. (brad.hill@honeywell.com); David Goldstein, representing Natural Resources Defense Council (dgoldstein.nrdc@gmail.com)

2024 International Energy Conservation Code [CE Project]

Add new text as follows:

APPENDIX CG

ALL-ELECTRIC COMMERCIAL BUILDING PROVISIONS

SECTION CG101
GENERAL

CG101.1 Intent. The intent of this Appendix is to amend the *International Energy Conservation Code* to reduce greenhouse gas emissions from buildings and improve the safety and health for commercial building occupants by requiring new *all-electric buildings* and efficient electrification of existing buildings.

CG101.2 Scope. The provisions in this appendix are applicable to commercial buildings. New construction shall comply with Section CG103. *Additions*, *alterations*, *repairs* and *changes of occupancy* to existing buildings shall comply with Chapter 5 and Section CG104.

SECTION CG102
DEFINITIONS

CG102 ALL-ELECTRIC BUILDING. A *building* that contains no *combustion equipment*, or plumbing for *combustion equipment,* installed within the *building* or *building site.*

CG102 APPLIANCE. A device or apparatus that is manufactured and designed to utilize energy and for which this code provides specific requirements.

CG102 COMBUSTION EQUIPMENT. Anyequipment or *appliance* used for space heating, *service water heating*, cooking, clothes drying, humidification, or lighting that uses *fuel gas* or *fuel oil*.

CG102 FUEL GAS. Natural gas, manufactured gas, liquified petroleum gas or a mixture of these.

CG102 FUEL OIL. Kerosene or any hydrocarbon oil having a flash point not less than 100°F (38°C).

CG102 SUBSTANTIAL ENERGY ALTERATION. An *alteration* that includes replacement of two or more of the following:

1. 50 percent or greater of the area of interior wall-covering material of the b*uilding thermal envelope* or *fenestration*.
2. 50 percent or greater of the area of the exterior wall-covering material of the *building thermal envelope* or *fenestration*.
3. Space-conditioning equipment constituting 50 percent or greater of the total input capacity of the space heating or space cooling equipment serving the *building*.
4. Water-heating equipment constituting 50 percent or greater of the total input capacity of all the water heating equipment serving the *building*.
5. 50 percent or greater of the luminaires in the *building.*

CG102 SUBSTANTIAL IMPROVEMENT. Any *repair*, reconstruction, rehabilitation, *alteration*, *addition* or other improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the improvement or repair is started. If the structure has sustained *substantial damage*, any repairs are considered substantial improvement regardless of the actual *repair* work performed. The term does not, however, include either:

1. Any project for improvement of a *building* required to correct existing health, sanitary or safety code violations identified by the *building official*

and that are the minimum necessary to assure safe living conditions.

2. Any *alteration* of a *historic structure* provided that the *alteration* will not preclude the structure's continued designation as a historic structure.

SECTION CG103

NEW COMMERCIAL BUILDINGS

CG103.1 Application. New commercial buildings shall be *all-electric buildings* and comply with Sections C401.2.1 or C401.2.2.

CG103.2 Electric resistance heating equipment. The sole use of electric resistance equipment and appliances for space and water heating shall be prohibited other than for *buildings* or portions of *buildings* that comply with not less than one of Sections CG103.2.1 through CG103.2.8.

CG103.2.1 Low space heating capacity. Buildings or areas of buildings not served by a mechanical cooling system and with a total space heating capacity not greater than 4.0 BTU/h (1.0 watts) per square foot of *conditioned space* are permitted to be heated using electric resistance *appliances* or equipment.

CG103.2.2 Small systems. Buildings in which electric resistance *appliances* or equipment comprise less than 5 percent of the total system heating capacity or serve less than 5 percent of the *conditioned floor area*.

CG103.2.3 Specific conditions. Portions of buildings or specific equipment and appliances that require electric resistance heating that cannot practicably be served by electric heat pumps as approved by the code official.

CG103.2.4 Kitchen make-up air. Make-up air for commercial kitchen exhaust systems required to be tempered by Section 508.1.1 of the International Mechanical Code is permitted to be heated by electric resistance.

CG103.2.5 Freeze protection. Use of electric resistance heat for freeze protection shall comply with Sections CG103.2.5.1 through CG103.2.5.2.

CG103.2.5.1 Low indoor design conditions. Space heating systems sized for spaces with indoor design conditions of no higher than 40°F (4.5°C) and intended for freeze protection, including temporary systems in unfinished spaces, are permitted to use electric resistance. The building envelope of any such space shall be insulated in compliance with Section C402.1.

CG103.2.5.2 Freeze protection systems. Freeze protection systems shall comply with Section C403.13.3.

CG103.2.6 Pre-heating of outdoor air. Systems with energy recovery ventilation are permitted to utilize electric resistance to preheat outdoor air for defrost or temper supply air to not more than 45°F (7.2°C). Hydronic systems without energy recovery ventilation are permitted to utilize electric resistance to temper supply air to not more than 40°F (4.5°C).

CG103.2.7 Small buildings. Buildings with a conditioned floor area of not more than 250 square feet (23.2 m^2) and not served by a mechanical space cooling system shall be permitted to use electric resistance *appliances* or equipment for space heating.

CG103.2.8 Supplemental heat. Electric resistance heat shall be permitted as supplemental heat when installed with heat pumps sized in accordance with Section CG103.3 and when operated only when a heat pump cannot provide the necessary heating energy to satisfy the thermostat setting.

CG103.3 Heat pump sizing for space heating. Heat pump space heating systems shall be sized to meet the *building* heating load at the greater of 0°F (-18°C) or the 99 Percent Annual Heating Dry-Bulb for the nearest weather station provided in the ASHRAE Handbook of Fundamentals. The heat pump space heating system shall not require the use of supplemental electric heat at or above this temperature other than for defrosting. Lower capacity heat pumps that operate in conjunction with thermal storage shall be permitted if the system meets the requirements of this section.

CG103.4 Heat pump sizing for water heating. Heat pump *service heating systems* shall be sized to meet not less than the *building service water heating* load at the greater of 15°F (-18°C) or the 99 Percent Annual Heating Dry-Bulb for the nearest weather station provided in the latest edition of the ASHRAE Fundamentals Handbook. Supplemental electric heat shall not be required at or above this temperature other than for temperature maintenance in recirculating systems and defrosting.

CG103.5 Heating outside a building. Systems for heating outside a building shall comply with C403.13.1.

CG103.6 Cooling equipment. New unitary air conditioners shall be electric heat pump equipment sized and configured to provide both space cooling and space heating.

SECTION CG104 EXISTING COMMERCIAL BUILDINGS

CG104.1 Combustion equipment in additions. *Additions* shall not be permitted to contain *combustion equipment* and new equipment installed to serve *additions* shall not be *combustion equipment*. Where systems with *combustion equipment* are extended into an addition, the existing *building* and addition together shall use no more fossil fuel energy than the existing *building* alone.

CG104.2 Substantial improvement. Buildings undergoing *substantial improvements* shall be *all-electric buildings*, comply with C402.5 and meet a site EUI by building type in accordance with ASHRAE Standard 100 Table 7-2a.

Exception: Compliance with Standard 100 shall not be required where Group R occupancies achieve an ERI score of 80 or below without on-site renewable energy included in accordance with RESNET/ICC 301, for each dwelling unit.

CG104.3 Additional energy efficiency credits for substantial energy alterations. *Substantial energy alterations* of *all-electric buildings* shall comply with Section C503.6 and *mixed-fuel* buildings shall achieve not less than two times the number of required efficiency credits from Section C503.6.

Exceptions:

1. Alterations that are part of an addition complying with section CG104.1.
2. Alterations that comply with Section C407.
3. Alterations that comply with Section CG104.2.

CG104.4 Cooling equipment. New and replacement unitary air conditioners shall be electric heat pump equipment sized and configured to provide both space cooling and space heating. Any existing space heating systems other than existing heat pump equipment that serve the same zone as the new equipment shall be configured as supplementary heat in accordance with Section CG104.7.

CG104.5 Service water heating equipment. Where service water heating equipment is added or replaced, new service hot water equipment shall not be *combustion equipment*.

CG104.6 Furnace replacement. Newly installed warm air furnaces provided for space heating shall only be permitted as supplementary heat controlled in accordance with Section CG104.7.

CG104.7 Heat pump supplementary heat. Heat pumps having *combustion equipment* or electric resistance equipment for supplementary space or *service water heating* shall have controls that limit supplemental heat operation to only those times when one of the following applies:

1. The heat pump is operating in defrost mode.
2. The vapor compression cycle malfunctions.
3. For space heating systems, the thermostat malfunctions.
4. For space heating systems, the vapor compression cycle cannot provide the necessary heating energy to satisfy the thermostat setting.
5. The outdoor air temperature is less than the design temperature determined in accordance with Section CG103.3.
6. For *service water heating*, the heat pump water heater cannot maintain an output water temperature of at least 120°F (49°C) .
7. For temperature maintenance in *service water heating* systems.

New supplementary space and *service water heating* systems for heat pump equipment shall not be permitted to have a heating input capacity greater than the heating input capacity of the heat pump equipment.

Add new standard(s) as follows:

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100-2018 Energy Efficiency in Existing Buildings

Reason: In order for the U.S. to reach net zero carbon emissions, the country must not only reduce energy use through energy efficiency and move to utility scale and on-site renewable energy, but also begin to transition away from using combustion equipment in buildings that runs on fossil fuels to electric equipment. In 2021, combustion equipment in commercial and residential buildings accounted for 35% of US greenhouse gas emissions.[1] The purpose of a model code is to provide cities and states with a starting point on which each jurisdiction can base their energy code. Growing interest in establishing all-electric building requirements is evidenced by several cities and states passing ordinances banning fossil fuel combustion equipment in buildings including Washington DC, New York City, Ithaca, New York; Brookline, Massachusetts; Berkeley, Los Angeles, Sacramento, San Francisco, Oakland and San Jose, California; and Washington State. Including an appendix in the 2024 IECC that specifies requirements for all-electric commercial construction will streamline adoption and implementation of all-electric construction for policy makers and the building industry. We strongly encourage that the code language in this appendix minimizes the use of inefficient electric resistance heat for space heating in new buildings to avoid an unintended consequence of higher operational costs and carbon emissions for the life of the building. Attached is a letter with others stating the support for this proposal from 50 organizations, 16 of which are from local or state governments and universities, 12 of which are from NGOs, and 22 of which are from design and construction industry. In addition to the letter of support, this proposal includes more than 30 co-proponents.

All-electric buildings not only reduce carbon emissions but are also healthier for building occupants. Gas appliances release harmful pollutants like nitrogen dioxide (NO_2) and carbon monoxide (CO) either indoors because of gas stoves or outdoors because of space-heating and water heating equipment. A recent study from the Harvard Chang School of Public Health and RMI shows that in Illinois in 2017, air pollution from burning fuels in buildings led to an estimated 1,123 early deaths and $12.574 billion in health impact costs.[2] These emissions can particularly affect children. In a meta-analysis analyzing the connections between gas stoves and childhood asthma, children in homes with gas stoves were 42% more likely to experience asthma symptoms, and 32% more likely to being diagnosed with asthma. [3]Therefore, ensuring all-electric appliances are installed is

critical to reducing air pollution, protecting public health, reducing utility and construction costs, and meeting climate goals.NBI, ACEEE, and 2050

Partners on behalf of the California Investor Owned Utilities worked together to address many of the technical concerns raised when NBI's original proposal, CEPI-22, was discussed in June of 2022. The main revisions to this proposal include:

1. Separating the original CEPI-22 proposal into three pieces, an electric-ready proposal, an all-electric appendix, and a requirement for more energy efficiency credits in buildings that do not primarily use heat pumps for space and water heating. Each piece stands alone with its own independent support, so each proposal can be discussed and voted on separately.

2. Ensuring that jurisdictions encourage efficient electrification by only allowing the use of electric resistance heat for space and water heating in certain applications.

3. Additional requirements on appropriately sizing heat pumps for space heating and water heating are included so that electric resistance heat for supplementary heat is reduced. 2050 partners is conducting additional modeling to for a variety of building types in multiple climate zones to determine if additional requirements are needed. This modeling is not yet complete but will be complete before the commercial consensus committee considers this proposal.

4. A new section addressing the use of combustion equipment in existing buildings. This new section:

   a. Does not permit new combustion equipment in additions

   b. Requires buildings undergoing a substantial improvement, defined as work that exceeds 50% of the market value of the structure to both be all-electric and meet EUI targets outlined in ASHRAE Standard 100.

   c. Incentivizes heat pumps in new buildings by requiring buildings undergoing a substantial energy alteration to achieve additional energy efficiency credits.

   d. Requires new and replacement cooling equipment to be electric heat pump equipment configured to provide both space cooling and space heating and requires existing space heating systems that are not heat pump systems are required to provide supplementary heat.

   e. Requires new or replacement service hot water equipment to be electric.

   f. Requires new furnaces provided for space heating to only be permitted to be used as supplementary heat.

   g. Reduces the use of electric resistance and combustion equipment for supplementary heat through the use of improved controls.

Cost Impact: The code change proposal will decrease the cost of construction.
All-electric commercial buildings are less expensive to build than mixed fuel buildings because electric appliances and equipment are typically less expensive than combustion equipment and appliances. In additional developers avoid the cost of installing natural-gas lines and meters. Recent analysis by NBI and partners utilizing data from RS Means indicates that an all-electric 53,000 s.f. office building with a central heat pump water heater and minimum code compliant air source heat pump costs $0.07/s.f. to $0.24/s.f. less to build than a mixed-fuel office building of the same size. [4] Additional analyses from a recent CASE study indicate that all-electric high-rise multifamily buildings are also less expensive to build and operate than mixed-fuel buildings. HVAC costs, for example, are on the order of $2,504 to $7,131 lower per dwelling unit depending on the HVAC system installed. Installing electric space heating and water heating equipment instead of natural gas equipment in the majority of California's climate zones also yielded a positive benefit to cost ratio over the 15- year analysis period despite California's high electricity rates. This is perhaps why close to half of commercial buildings currently do not use natural gas. [5] Moving to all-electric construction also results in more stable utility bills because electricity prices are not as volatile as natural gas prices. [6]

Bibliography: [1] "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." *Energy and the Environment Explained: Where Greenhouse Gases Come From*, U.S. Energy Information Administration (EIA), https://www.eia.gov/energyexplained/energy-and-the-environment/where-greenhouse-gases-come-from.php#:~:text=In%202021%2C%20petroleum%20accounted%20for,energy%2Drelated%20CO2%20emissions.

[2] *Health Air Quality Impacts of Buildings Emissions*. RMI, 5 May 2021, rmi.org/health-air-quality-impacts-of-buildings-emissions#MI.

[3] *Gas Stoves: Health and Air Quality Impacts and Solutions.* RMI, 1 Feb. 2021, rmi.org/insight/gas-stoves-pollution-health/.

[4]*Cost Study of the Building Decarbonization Code* , New Buildings Institute, Apr. 2022, https://newbuildings.org/wp-content/uploads/2022/04/BuildingDecarbCostStudy.pdf.

[5]"U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." *Commercial Buildings Energy Consumption Survey (CBECS)*, Energy Information Administration (EIA), 2018, https://www.eia.gov/consumption/commercial/data/2018/pdf/CBECS_2018_Building_Characteristics_Flipbook.pdf.

[6] Slanger, Dan. *Reality Check: The Myth of Stable and Affordable Natural Gas Prices*, RMI, 5 May 2022, https://rmi.org/the-myth-of-stable-and- affordable-natural-gas-prices/.

Attached Files

- **Commercial Electrification Sign On Letter 2024 IECC.pdf**

  https://energy.cdpaccess.com/proposal/810/1704/files/download/384/

Workgroup Recommendation

Proposal # 810
