CE2D-90-23

IECC CE: CH, CH103, CH103.1, CH103.1.1, TABLE CH103.1.1, CH103.1.1.1, CH103.1.1.2 (New), CH103.1.1.2, CH103.1.1.3, CH103.1.2, TABLE CH103.1.2, CH103.1.2.1, CH103.1.2.2, CH103.1.2.3, CH103.1.2.4, CH103.1.3, CH103.1.3.1, TABLE CH103.1.3.1, CH103.1.3.2, CH103.1.4, CH103.1.4.1, CH103.1.4.2, CH103.1.5, CH103.2, CH103.3

Proponents:

Michele Mihelic, representing The American Institute of Architects (AIA) (michelemihelic@aia.org)

2024 International Energy Code[CE Project] R3

CH ELECTRIC-~~READY~~ CAPABLE COMMERCIAL BUILDING PROVISIONS

CH103 — NEW COMMERCIAL BUILDING

CH103.1 Additional electric infrastructure.

Electric infrastructure in buildings that contain combustion equipment shall be installed in accordance with this section.

CH103.1.1 Combustion space heating.

Spaces containing combustion equipment for space heating shall comply with Sections CH103.1.1.1, CH103.1.1.2 and CH103.1.1.3.

TABLE CH103.1.1 ALTERNATE ELECTRIC SPACE HEATING EQUIPMENT CONVERSION FACTORS (VA/kBtu/h)

CH103.1.1.1 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.

Add new text as follows:

CH103.1.1.2 Electric service capacity for future electric space heating equipment.

Where the addition of future electric space heating equipment would require an increase in the capacity of the electric service capacity for the building, provisions should be made for future increase in the capacity, including designated space for larger and or additional utility transformers to serve the building and additional conduit from the transformer location to the main electrical panel for the building.

Revise as follows:

Distribution infrastructure

~~CH103.1.1.2~~ CH103.1.1.2.1 ~~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. The branch circuit shall~~ a conduit run sufficient to convey 208/240v, 50Amp

conductors from the main electrical panel and terminating ~~terminate~~ within 6 feet (1829 mm) of the space heating equipment. ~~and be in a location with ready access. 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 CH103.1.1.3, and terminating in a junction box within 3 feet (914 mm) of the location the space heating equipment in a location with ready access. Both ends of the branch circuit shall be labeled "For Future Electric Space Heating Equipment."~~

The main panel shall include a reserved breaker space sufficient to serve future space heating equipment and 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 CH103.1.1.3
2.	Where a branch circuit provides electricity to space cooling equipment and is rated and sized in accordance with Section CH103.1.1.3.
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 CH103.1.1.3.
4.	Buildings where the 99.6 percent design heating temperature is not less than 50°F (10°C)

CH103.1.1.3 Additional space heating electric infrastructure sizing.

Electric infrastructure for future electric space heating equipment shall be sized toaccommodate not less than one of the following:

1.	An electrical capacity not less than the nameplate space heating combustionequipment heating capacity multiplied by the value in Table CH103.1.1 $VA_s = Q_{com} \times P_s$ Equation CH-1 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 CH103.1 in VA/kBtu/h
2.	An electrical capacity not less than the peak space heating load of the buildingareas served by the space heating combustion equipment, calculated inaccordance with Section C403.1.1, multiplied by the value for the 99.6 percentdesign heating temperature in Table CH103.1.1 per the equation below, or $VA_s = Q_{design} \times P_s$ Equation CH-2 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 thecombustion equipment in kBtu/h P_s = The VA per kBtu/h from Table CH103.1.1 in VA/kBtu/h
3.	An *approved* alternate design that uses no energy source other than electricity or *on-site renewable energy*.

CH103.1.2 Combustion service water heating.

Spaces containing combustion equipment for service water heating shall comply with Sections CH103.1.2.1, CH103.1.2.2 and CH103.1.2.3.

TABLE CH103.1.2 ALTERNATE ELECTRIC WATER HEATING EQUIPMENT CONVERSION FACTORS (VA/kBtu/h)

Revise as follows:

Distribution Infrastructure for Future Electric Small Domestic Water Heating Equipment

CH103.1.2.1 ~~(NEED TITLE)~~.

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:

conduit sized to convey conductors

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".~~ The panel serving the device shall have a reserved breaker space sufficient to serve the future electric water heating equipment. The reserved breaker space and conduit run shall be labeled for " Future Electric Water Heater".
3.	The space for containing the future *water heater* shall include the space occupied by the combustion equipment and 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 ft^3 (20 m^3).

Exception: 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.~~

4

CH103.1.2.2 ~~Designated locations~~ for future electric heat pump water heating equipment.

1.	Designated exterior location(s) shown on the plans and of sufficient size for outdoor water heating heat pump equipment, with a chase that is sized to accommodate refrigerant lines between the exterior location and the interior location of the water heating equipment.
2.	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. The interior location shall include the space occupied by the combustion equipment.
3.	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 (203mm) duct of no more than 10 feet (3048 mm) in length for cool exhaust air.

indoor

Move to below

2

CH103.1.2.3 ~~Dedicated branch circuits~~ for future electric heat pump water heating equipment.

Distribution Infrastructure

large

3

Spaces containing combustion equipment for water heating with a capacityof greater than 75,000 Btu/h shall be provided with a ~~dedicated branch circuit rated and~~ sized in accordance with Section CH103.1.2.~~4~~ and terminating in a junction box within 3feet (914 mm) of the location the water heating equipment in a location with ready access. Both ends of the ~~branch circuit~~ shall be labeled “For Future

conduit

conduit

Electric Water Heating Equipment."

Exception: Where future electric water heating equipment would require threephase power and the main electrical service panel has a reserved space for a bus bar rated and sized in accordance with Section CH103.1.2.4 and labeled "For Future Electric Water Heating Equipment."

Revise as follows:

CH103.1.2.~~4~~ 3 Additional water heating electric infrastructure sizing.

Electric infrastructure accommodations for future 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 CH103.1.2 plus electrical capacity to serve recirculating loads as shown in the equation below. $VA_w = (Q_{capacity} \times P_w) + (Q_{recirc} \times 293\ (VA/(Btu/h))$ Equation CH-3 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 P_w = The VA per kBtu/h from Table CH103.1.2 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.*

CH103.1.3 Combustion cooking.

Spaces containing combustion equipment for cooking shall comply with either CH103.1.3.1 or CH103.1.3.2

Revise as follows:

CH103.1.3.1 Commercial cooking.

Spaces containing commercial cooking appliances shall be provided with a ~~dedicated branch~~ conduit sized for a circuit with an ~~minimum~~ electrical ampacity in accordance with Table CH103.1.3.1 based on the appliance in the space. The ~~branch circuit~~ conduit shall run from the panel to terminate within 3 feet (914 mm) of the appliance in a location with ready access. ~~Both ends of the branch circuit shall be labeled with the words "For Future Electric Cooking Equipment" and be electrically isolated.~~

The panel shall be provided with a reserved breaker space sufficient to serve the future space heating equipment based on the capacities specified in CH103.1.3.1. The reserved breaker space and conduit shall be labeled for "Future Electric Space Heating Equipment

TABLE CH103.1.3.1 COMMERCIAL COOKING MINIMUM BRANCH CIRCUIT CAPACITY

CH103.1.3.2 All other cooking.

conduit sized to contain conductors sized

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 in a location with ready access. Both ends of the ~~branch circuit~~ shall be labeled with the words "For Future Electric Cooking Equipment" and be electrically isolated.

conduit

CH103.1.4 Combustion clothes drying.

Spaces containing combustion equipment for clothes drying shall comply with either CH103.1.4.1 or CH103.1.4.2

CH103.1.4.1 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 capacity 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.”

The panel shall be provided with breaker space sufficient to serve electrical equipment with an equivalent equipment capacity

Revise as follows:

CH103.1.4.2 Residential drying.

Spaces containing clothes drying equipment, appliances, and end-uses serving multiple dwelling units or sleeping areas with a capacity less than or equal to 9.2 cubic feet shall be provided with ~~a dedicated 240-volt branch circuit with a minimum capacity of 30A and shall terminate~~ with an empty conduit sufficient to convey 208/240v, 30Amp conductors running from the main electrical panel terminating within 6 feet (1829 mm) of fossil fuel clothes dryers and shall be in a location with ready access. ~~Both ends of the branch circuit shall be labeled with the words “For Future Electric Clothes Drying Equipment” and be electrically isolated.~~

The panel shall be provided with a reserved breaker space sufficient to serve the future clothes drying equipment based on a 208/240v, 30Amp load. The reserved breaker space and conduit shall be labeled as reserved for future “Electric Space Heating Equipment”.

CH103.1.5 On-site transformers.

Enclosed spaces and underground vaults containing onsite electric transformers on the building side of the electric utility meter shall have sufficient space to accommodate transformers sized to serve the additional electric loads identified in CH103.1.1, CH103.1.2, CH103.1.3 and CH103.1.4.

CH103.2 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).

CH103.3 Construction documentation.

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.

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/.

Cost Impact:

The code change proposal will increase the cost of construction.

The code change proposal will increase the cost of construction.

Recent analysis by NBI and partners using cost data from RSMeans for a medium office indicates that additional electrical infrastructure costs for water-heating and space-heating would cost a typical office building an additional $0.09 per square foot of conditioned floor area. [4] However, if a building owner were to have to retrofit their building from using combustion equipment to natural gas equipment costs without these requirements in place, costs could be exorbitant. California Energy Codes & Standards “2021 Reach Code Cost-Effectiveness Analysis: Non-Residential Alterations” report estimated labor costs for electrification retrofit of mechanical systems as a 25 to 50% increase from new construction labor cost due to building-specific considerations such as tight conditions, prepping surfaces, elevated work, material handling, specialty rigging, and protecting existing finishes that can vary building to building. [5]

CE2D-90-23