nbi new buildings institute

Building Decarbonization Code

An overlay to the International Energy Conservation Code on the path to net zero

February 2021

Version 1.0

Albuquerque, NM

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Acknowledgments

We gratefully acknowledge the following individuals for their contributions and insights into the development of the Building Decarbonization Code.

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Introduction and Background

Building electrification and decarbonization policies are being discussed by states and cities across the country. These policies address the transition away from onsite fossil fuel combustion in buildings, as the electricity grid (including renewable energy sources) move towards 100 percent carbon-free. That is, decarbonization in these policies is the process of moving new and existing buildings towards the highly efficient use of 100 percent carbon-free sources of energy.

Many jurisdictions have aggressive climate-related goals, and over 200 cities have made pledges to achieve 100 percent clean energy or "net zero" emissions.[1] Ensuring that new buildings emit little – or no – carbon is an important component of meeting these goals. Cities in California are leading the way, with around 30 cities that have already adopted or are in the process of adopting electrification reach codes for new buildings. Outside of California, cities and states are very interested in decarbonization-focused model code language. Local governments and the advocates that work with them are searching for code tools that can help them easily replicate the wave of local action that has swept California in the last year.

The recent efficiency gains in the International Code Council's (ICC) 2021 International Energy Conservation Code (IECC), creates ideal timing to look at a "decarbonization overlay" to the model code. The language in this Building Decarbonization Code is fully compatible with the current structure of the IECC, covering both residential and commercial construction. Recognizing that not every jurisdiction is looking to require all-electric equipment in their next code cycle, and many jurisdictions are looking for electric-ready and electric-preferred options for new construction, both options are presented here. The current overlay focuses on codes for new construction only, and staff at New Buildings Institute (NBI) is exploring the potential of adding code language for existing buildings in a future version.

The overlay incorporates code solutions to the inclusion of key electrification technologies including solar energy production, electric vehicles, battery storage, and demand response. The inclusion of these code measures may seem additive, but in fact as the building stock increases its reliance on the electric grid buildings built with these grid integration technologies will be relied upon as grid assets, able to help shift, shape, and shave the peaks of the electric load, rather than bringing new generation resources online, making them critical components of the new era of all-electric buildings.

200+
CITIES

have made pledges to achieve 100 percent clean energy or "net zero" emissions.

LEADING THE WAY

Cities in California are leading the way, with around **30 cities** that have already adopted or are in the process of adopting electrification reach codes for new buildings.

1 **https://www.nrdc.org/resources/race-100-clean**

Key Electrification Technologies for Future-Proofing Buildings

SOLAR ENERGY PRODUCTION

Solar energy is a critical component of construction to achieve climate goals. Even with a cleaning electricity supply and clear targets from cities and states moving to 100% clean energy, distributed solar will continue to play a role both in meeting those goals, but also in allowing for the futureproofing of new construction. Buildings with solar generation will have lower monthly utility bills through production and use of on-site energy and have a dedicated source of energy to use and store as needed during grid outages. Requirements for solar ready infrastructure in residential construction create the opportunity for consumer choice and remove the high potential costs of retrofit installation after construction.

BATTERY STORAGE

As efficient buildings and clean or renewable energy generation are cited as key components of goals of many jurisdictions targeting carbon neutrality, a missing piece of the puzzle is how to handle energy needs during hours where the renewable generation is not appropriately matched to the demand. Including storage in the design and development of buildings is the next step. Storage solutions will not only benefit building owners and residents in helping to decrease demand charges, but also contribute to the vision of grid-interactive buildings and vehicles, where all pieces of the energy system are working in coordination. Energy storage also provides resilience benefits, allowing continued operation amidst power outages caused by disaster events or to preempt potential disasters like wildfires.

ELECTRIC VEHICLES

The widescale adoption of electric vehicles (EVs) is a key climate strategy to reduce. In the United States, EV sales increased by 80 percent from 2017 to 2018.[2] According to a November 2018 forecast from the Edison Electric Institute, the number of EVs on U.S. roads is projected to grow from 1 million vehicles at the end of 2018, to 18.7 million by 2030. To recharge these new EVs, the U.S. will need 9.6 million charge ports, a substantial portion of which will be installed in single and multi-family residential buildings.[3] The lack of access to EV charging stations continues to be a critical barrier to EV adoption. In particular, there are significant logistical barriers for residents of multi-family dwellings to upgrade existing electrical infrastructure and install new EV charging stations. A lack of pre-existing EV charging infrastructure can make the installation of a new charging station cost-prohibitive for a potential EV-owner, creating significant barriers to the adoption of EVs.

DEMAND RESPONSE

It is also critical that buildings be able to support grid operation more directly by responding to fluctuations in grid load and contributing to efforts to manage more diverse grid resources. This overlay itself adds to the growing increase of distributed energy resources by requiring solar, electric vehicle, and energy storage infrastructure. All new buildings must incorporate demand management controls that allow short term load response to grid peak to support a changing electric grid scenario.

2 "Monthly Plug-In EV Sales Scorecard." Inside EVs: Monthly U.S. Plug-in EV Sales Report Card. Accessed January 2019. **https://insideevs.com/monthly-plug-in-sales-scorecard/**.

3 Edison Electric Institute. Electric Vehicle Sales Forecast and the Charging Infrastructure Required Through 2030. Report. November 2018. Accessed January 2019.

How to Use This Document

Potential amendments are presented for Commercial and Residential construction covering two jurisdiction options**:**

1

ALL-ELECTRIC

2

MIXED-FUEL

Each section of commercial and residential construction covers both fuel scenarios.

Mixed-Fuel provisions in the Building Decarbonization Code provide electric-ready construction that allows for simple, low-cost all-electric technology installation at some point in the future.

The code amendments are presented in strikethrough and underline **formatting** that is commonly used in amendment process.

The ~~strikethrough~~ markup indicates the deletion of portions of code text.

The underline markup indicates the addition of portions of code text.

Amendments are followed by narrative text where needed to explain why a change was made, how the code relates to other I-Code language, and/or why certain exceptions were carved out in the new language to be more permissive. Narrative text should be removed for any formal adoption process or repurposed as background information or a reason statement.

Jurisdictions may use either section of the overlay in its entirety or use portions of either or both to amend the 2021 IECC to a code that is right for adoption to meet the needs of their communities and supports their climate goals.

To access word documents of both the residential and commerical language, visit **newbuildings.org/resource/building-decarbonization-code**

Building Decarbonization Code:

Commercial Language

All-Electric

IECC - Commercial Provisions (All-Electric)

Chapter 1 – Scope and Application

C101 SCOPE AND GENERAL REQUIREMENTS

Revise as follows:

C101.3 Intent. This code shall regulate the design, and construction of buildings for the ~~effective use and conservation~~ reduction of greenhouse gas emissions and for the efficient production, use and storage of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Intent has been modified to include consideration of greenhouse gas emissions as well as both production and storage of energy.

C103 CONSTRUCTION DOCUMENTS

Revise as follows:

C103.2 Information on construction documents. Construction documents shall be drawn to scale upon suitable material. Electronic media documented are permitted to be submitted when *approved* by the *code official*. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment herein governed. Details shall include the following as applicable:

6. Mechanical and service water heating systems and equipment types, sizes, fuel source and efficiencies.

Fuel sources are a critical piece of code compliance enforcement for the full implementation of this code overlay. Clear identification on the construction documents will allow for easier code compliance review and inspections. Inclusion of fuel sources is most critical in areas where there are multiple fuels available such as fuel oil, propane, and natural gas, as the equipment type alone may not provide this information.

14. Location of pathways for routing of raceways or cable from the renewable energy system to the electrical service panel and electrical energy storage system area.

15. Location and layout of a designated area for electrical energy storage system.

For ease of enforcement, information for both renewable energy and electrical energy storage have been included as part of construction documents. Language has been migrated from Appendix CB Solar-Ready Zone to the applicable location in the base code and modified to fit into current structure.

16. Location of designated *EVSE spaces*, *EV-Ready spaces*, and *EV-Capable spaces* in parking facilities.

To assist in enforcement of electric vehicle infrastructure requirements, and to serve as a plan for full installation of EVSE equipment in EV-ready and EV-capable spaces in the future, plans should clearly indicate the intended locations of EV infrastructure.

Chapter 2 – Definitions

C202 GENERAL DEFINITIONS

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.

Definition of appliance is mirrored from 2021 IMC to be useful in defining combustion equipment.

AUTOMATIC LOAD MANAGEMENT SYSTEMS (ALMS). A control system that allows multiple connected *EVSE* to share a circuit or panel and automatically reduce power at each charger, reducing the total connected electrical capacity of all *EVSE*.

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 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.

Definition of commercial cooking appliances is mirrored from the 2021 International Fire Code for use in defining requirements for additional electric infrastructure required for cooking under Section C405.14.3.

DEMAND RESPONSIVE CONTROL. An automatic control that can receive and automatically respond to demand response requests from a utility, electrical system operator, or third-party demand response program provider.

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current. Plug-in hybrid electric vehicles are electric vehicles having a second source of motive power. Off-road, self-propelled electric mobile equipment, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats and the like, are not considered electric vehicles.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded, and equipment grounding conductors and the *electric vehicle* connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the *electric vehicle*.

Definitions for EV and EVSE are mirrored from NEC-2020 to be useful in defining requirements for electric vehicle infrastructure.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE) SPACE. A designated parking space with dedicated *electric vehicle supply equipment* capable of supplying not less than 6.2 kW to an *electric vehicle* located within 3 feet (914 mm) of the parking space.

The charging rate for an EVSE space is set at 6.2 kW. This is equivalent to a 30A/208V EVSE. 30 and 32A chargers are the most common Level 2 chargers and the highest capacity chargers that can be installed on a 40A branch circuit. kW is used as the metric to indicate total power delivered rather than the specific combination of Volts and Amps.

EQUIPMENT. Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

Definition of equipment is mirrored from 2021 IMC to be useful in defining combustion equipment.

EV-CAPABLE SPACE. A parking space that is provided with conduit that meets the following requirements:

1. The conduit shall be continuous between a junction box or receptacle located within 3 feet (914 mm) of the parking space and an electrical panel serving the area of the parking space with sufficient dedicated physical space for a dual-pole, 40-amp breaker
2. The conduit shall be sized and rated to accommodate a 40-amp, 208/240-volt branch circuit and have a minimum nominal trade size of 1 inch
3. The electrical junction box and the electrical panel directory entry for the dedicated space in the electrical panel shall have labels stating “For future *electric vehicle* charging”

EV-READY SPACE. A parking space that is provided with dedicated branch circuit that meets the following requirements:

1. Wiring capable of supporting a 40-amp, 208/240-volt circuit,
2. Terminates at a junction box or receptacle located within 3 feet (914 mm) of the parking space, and
3. The electrical panel directory shall designate the branch circuit as “For electric vehicle charging” and the junction box or receptacle shall be labelled “For electric vehicle charging”.

EV Ready and EV Capable definitions do not include requirements for minimum capacity for the branch circuit. Different levels of capacity are appropriate for different EV charging scenarios (charging at different building types, parking types, residential types, business types, times of day, etc.) as well as different levels of penetration of EV charging spaces in a parking lot. Therefore, capacity requirements

are set in the code text itself to allow for consistent use of the definitions while the capacity requirements change to match the specific EVCI requirements of the jurisdiction.

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

Definition of fuel gas is mirrored from 2021 IMC to be useful in defining combustion equipment.

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

Definition of fuel oil is mirrored from 2021 IMC to be useful in defining combustion equipment.

MIXED-FUEL BUILDING. A *building* that contains *combustion equipment* or includes piping for such *equipment*.

RENEWABLE ENERGY CERTIFICATE (REC). An instrument that represents the environmental attributes of one megawatt-hour of renewable electricity; also known as an energy attribute certificate (EAC).

Chapter 4 – Commercial Energy Efficiency

C401 GENERAL

Revise text as follows:

C401.2 Application. Commercial buildings shall be *all-electric buildings* and shall comply with Section C401.2.1 or C401.2.2.

The change in application requires that new construction be all-electric. Where a jurisdiction does not wish to require electrification of specific end uses but wants to advance electric buildings further than electric-readiness, exception language can be added. Where exception language is added, electric infrastructure language should be brought over from the mixed-fuel version of the overlay to ensure easy accessibility to future electric equipment installation. Recommended exception language is: Exception: The following combustion equipment is permitted as approved by the code official (list specific equipment types).

C402 BUILDING ENVELOPE REQUIREMENTS

Revise text as follows:

C402.1.1 Low energy buildings and greenhouses. The following low-energy buildings, or portions thereof separated from the remainder of the *building*-by-*building thermal envelope assemblies* complying with this section shall be exempt from the building thermal envelope provisions of Section C402.

1. Those containing no *combustion equipment* with a peak design rate of energy usage less than 3.4 Btu/h·ft2 (10.7 W/m2) or 1.0 watt/ft2 of floor area for space conditioning purposes.

C402.1.1.1 Greenhouses. Greenhouse structures or areas containing no *combustion equipment* that are mechanically heated or cooled and that comply with all of the following shall be exempt from the building envelope requirements of this code:

C402.1.2 Equipment buildings. Buildings that comply with the following shall be exempt from the *building thermal envelope* provisions of this code:

6. Contain no *combustion equipment*.

Low energy buildings are currently exempt from thermal envelope requirements. This revision applies the same intention of low greenhouse gas impact that was given to low energy use impact when these building types were exempted.

C403 BUILDING MECHANICAL SYSTEMS

Add new text as follows:

C403.4.1.6 Demand responsive thermostats. All thermostats shall be provided with *demand responsive controls* capable of increasing the cooling setpoint by no less than 4°F (2.2°C) and decreasing the heating setpoint by no less than 4°F (2.2°C).

Exception: Health care and assisted living facilities.

Demand responsive controls for thermostats are added based on language from California Title 24. In health care and assisted living facilities, thermostat setpoints can impact more than just thermal comfort, and temperature can be part of the health care being provided. To ensure that this requirement cannot have an adverse impact on those services, these facilities have been exempted from this requirement.

C404 SERVICE WATER HEATING

Revise text as follows:

C404.9.1 Heaters. The electric power to all heaters shall be controlled by an on-off switch that is an integral part of the heater, mounted on the exterior of the heater, or external to and within 3 feet (914 mm) of the heater in a location with ready access. Operation of such switch shall not change the setting of the heater thermostat. Such switches shall be in addition to a circuit breaker for the power to the heater. Gas-fired heaters shall not be ~~equipped with continuously burning ignition pilots~~ permitted.

All electric buildings will not need language that relates to fossil fuel systems. Vestigial language around pool heaters has been removed to avoid confusion in implementation of this overlay.

Add new text as follows:

C404.11 Demand responsive water heating. All electric water heating systems with a storage tank larger than 20 gallons (76 L) shall be provided with *demand responsive controls* that comply with ANSI/CTA-2045-B or another *approved demand responsive control*.

Exception: Health care facilities.

ANSI/CTA-2045-B standardizes the socket, and communications protocol, for heat pump water heaters so they can communicate with the grid, and with demand response signal providers. In addition, 2045-B adds control and communications requirements for mixing valves in HPWH to enable them to provide greater storage capacity to support increased load shifting. Versions of this standard are included in codes or other requirements in California, Oregon, and Washington

In health care facilities, such as hospitals, nursing facilities, and outpatient facilities, hot water can be critical to support the care being provided. To ensure that this requirement cannot have an adverse impact on those services, health care facilities have been exempted from this requirement.

C405 ELECTRICAL POWER AND LIGHTING SYSTEMS

Add new text as follows:

C405.2 Lighting controls. Lighting systems shall be provided with controls that comply with one of the following.

2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.4 and C405.2.5. The LLLC luminaire shall be independently capable of:
   2.4 Reducing lighting power in a uniform manner by no less than 10 percent when signaled by a *demand responsive control*.

This approach to DR controls for lighting limits the requirement to LLLC lighting, which uses control technology that generally already includes DR functionality or for which DR functionality comes at a minimal additional cost. The threshold for lighting power reduction is drawn from California's T24 DR requirements.

Revise text as follows:

C405.4.3 Gas lighting. Gas-fired lighting appliances shall not be ~~equipped with continuously burning pilot ignition systems~~ permitted.

While the use of gas lighting is nearly extinct for both indoor and outdoor new construction uses, gas lamps remain a nostalgic feature in historic neighborhoods. Since the IBC and IFGC do not prohibit the installation of fuel gas lighting, it is critical to ensure that the adoption of this overlay does prohibit these installations.

Revise table as follows:

TABLE C405.12.2 ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY CUSE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers, and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	Any single load that is not included in HVAC, lighting or plug load category and that exceeds 5 percent of the peak connected load of the whole building, including but not limited to data centers, manufacturing equipment, and commercial kitchens.
Electric vehicle charging	*Electric vehicle* charging loads.
Building operations and other miscellaneous	The remaining loads not included in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.

Electric Vehicle charging is a transportation load, not a building load, but is often provided through a building electrical service connection. Adding a category for monitoring EV charging separately allows the building load to be measured independently from this non-building load. This will be critical with the wider adoption of Building Performance Standards or other existing building energy use policies as it will allow EV charging to be easily excluded from the building loads for the purposes of regulating actual energy use in buildings.

Add new text as follows:

C405.13 On site renewable energy. Each building site shall have equipment for on-site renewable energy with a rated capacity of not less than 0.25 W/ft² (2.7 W/m²) multiplied by the sum of the gross conditioned floor area of the three largest floors.

Exceptions:

1. Any building located where an unshaded flat plate collector oriented towards the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 3.5 kWh/m²·day (1.1 kBtu/ft²·day).

2. Any building where more than 80 percent of the roof area is covered by any combination of equipment other than for on-site renewable energy systems, planters, vegetated space, skylights, or occupied roof deck.

3. Any building where more than 50 percent of roof area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2,500 annual hours between 8:00 AM and 4:00 PM.

C405.13.1 Renewable energy certificate documentation. Documentation shall be provided to the code official that indicates that renewable energy certificates (RECs) associated with the on-site renewable energy will be retained and retired by or on behalf of the owner or tenant.

A version of this requirement has been approved for ASHRAE 90.1-2019 as Addendum by,[4] and will be published in ASHRAE 90.1-2022. The three exceptions are written to ensure that the requirement is not being applied to buildings without adequate space on the roof, to buildings that are in areas of the country where unblocked insolation levels do not provide enough energy to make the equipment cost-effective (according to ASHRAE cost-effective criteria), and to buildings where solar access is wholly or partially blocked.

Add new text as follows:

C405.14 Electric vehicle charging infrastructure. Parking facilities shall be provided with electric vehicle charging infrastructure in accordance with Table C405.14 based on the total number of parking spaces and rounded up to the nearest whole number. Where more than one parking facility is provided on a building site, the number of parking spaces required shall be calculated separately for each parking facility. The branch circuit serving *EV ready spaces* shall have a minimum capacity of 1.8 kVA. *EVSE*, *EV ready spaces* and *EV capable spaces* may be counted toward meeting minimum parking requirements. *EVSE spaces* may be used to meet requirements for *EV ready spaces* and *EV capable spaces*. *EV ready spaces* may be used to meet requirements for *EV capable spaces.* An *ALMS* may be used to reduce the total electrical capacity required by *EVSE spaces* provided that all *EVSE spaces* are capable of simultaneously charging at a minimum rate of 1.4 kW.

Exception: In parking garages, the conduit required for *EV capable spaces* may be omitted provided the parking garage electrical service has no less than 1.8 kVA of additional reserved capacity per *EV capable space.*

[4] Addendum by to ASHRAE 90.1-2019 is posted at https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/90_1_2019_by_ck_cp_20200731.pdf

The EV charging infrastructure requirements have been tailored to different charging scenarios. EV Ready spaces are utilized in residential occupancies where EV owners are more likely to choose specific EVSEs with features that meet their personal, long-term needs. The minimum capacity of those EV Ready spaces has been set at Level 1 charging in order to maximize access to EV charging:

1. *Residential park times are generally much longer which makes Level 1 charging more feasible.*
2. *All EVs come with at least a Level 1 charger, eliminating the need for EV owners to invest in additional equipment to charge at their homes.*
3. *Level 1 charging minimizes the cost of enabling EV charging at a parking space, allowing for the maximization of the number of EV spaces, which maximizes access to charging.*

EVSE spaces are required for commercial parking lots where shorter parking times are typical and Level 2 or 3 parking is more appropriate. Additionally, while the car connection side of Level 2 EVSE are standard, the grid connection side is not, so utilizing EVSE rather than EV Ready spaces maximizes the utility of parking spaces in commercial lots that have more transient parking.

This EVCI language is based on the approach used in the electrification reach codes adopted by various California cities. It captures recent developments in the national conversation about the best way to bring EVCI requirements to code in a way that is consistent, understandable, feasible and ensures the societal benefit of the widest penetration of EV charging possible.

The exception is added to allow capacity to be substituted for conduit in parking garages. EVCI retrofits have different cost considerations in parking garages compared to surface parking lots. Parking garage retrofits do not require retrenching, so the conduit in EV capable spaces does not come with the same future avoided costs.

TABLE C405.14
ELECTRIC VEHICLE CHARGING INFRASTRUCTURE REQUIREMENTS

OCCUPANCY	***EVSE SPACES***	***EV READY SPACES***	***EV CAPABLE SPACES***
Group B Occupancies	15%	NA	40%
Group M Occupancies	25%	NA	40%
R-2 Occupancy	NA	100%[a]	NA
All other Occupancies	10%	NA	40%

a. Or one *EV ready space* per *dwelling unit.*

The percentages in Table C405.14 can be adjusted to tailor the requirements for the specific market needs of a jurisdiction. However, the EV Capable space requirements included for all commercial lots recognizes that future needs for EV charging will be much greater than they are now. EV capable spaces avoid the significant cost of parking lot re-trenching, which is one of the largest single costs of EVCI retrofits but only a minor investment in new construction.

Add new text as follows:

C405.15 Electric infrastructure for energy storage. Each building site shall have equipment for on-site energy storage not less than 2 feet (610 mm) in one dimension and 4 feet (1219 mm) in another dimension and located in accordance with Section 1206.2.8 of the International Fire Code and Section110.26 of the NFPA 70.

Exception: Where an onsite electrical energy system storage system is installed.

C405.15.1 Electrical service reserved space. The main electrical service panel shall have a reserved space to allow installation of a two-pole circuit breaker for future electrical energy storage system installation This space shall be labeled "For Future Electric Storage." The reserved spaces shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

Infrastructure for energy storage has been migrated up from Appendix CB Solar-Ready Zone into the main body of the code. This language includes revisions from the 2019 Group B Public Comment that were not incorporated into the final text of the 2021 IECC but modify the language to ensure needed correlation with the IFC and NFPA.

C406 ADDITIONAL EFFICIENCY REQUIREMENTS

Revise text as follows:

C406.5 Onsite renewable energy. The total minimum ratings of on-site renewable energy systems, not including onsite renewable energy system capacity used for compliance with Section C405.13, shall be one of the following:

With the addition of C405.13 for mandatory inclusion of onsite renewable energy this section is revised to allow only additional renewable energy to be counted toward compliance with the additional efficiency requirements.

Chapter 6 – Referenced Standards

Add new standard as follows:

CTA Consumer Technology Association
1919 S. Eads Street
Arlington, VA 22202

Standard reference number	Title	Referenced in code section number
ANSI/CTA-2045-B	Modular Communications Interface for Energy Management	C404.11

Building Decarbonization Code:

Commercial Language

Mixed-Fuel

IECC - Commercial Provisions (Mixed-Fuel)

Chapter 1 – Scope and Application

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> > 6. Mechanical and service water heating systems and equipment types, sizes, fuel source and efficiencies.

Fuel sources are a critical piece of code compliance enforcement for the full implementation of this code overlay. Clear identification on the construction documents will allow for easier code compliance review and inspections. Inclusion of fuel sources is most critical in areas where there are multiple fuels available such as fuel oil, propane, and natural gas, as the equipment type alone may not provide this information.

> > 14. Location of pathways for routing of raceways or cable from the renewable energy system to the electrical service panel and electrical energy storage system area.
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> > 15. Location and layout of a designated area for electrical energy storage system.

For ease of enforcement, information for both renewable energy and electrical energy storage have been included as part of construction documents. Language has been migrated from Appendix CB Solar-Ready Zone to the applicable location in the base code and modified to fit into current structure.

> > 16. Location of designated *EVSE spaces*, *EV-Ready spaces*, and *EV-Capable spaces* in parking facilities.

To assist in enforcement of electric vehicle infrastructure requirements, and to serve as a plan for full installation of EVSE equipment in EV-ready and EV-capable spaces in the future, plans should clearly indicate the intended locations of EV infrastructure.

Add new text as follows:

> **C103.2.2 Electrification system.** The construction documents shall provide details for additional electric infrastructure, including branch circuits, conduit, or pre-wiring, and panel capacity in compliance with the provisions of this code.

Current 2021 IECC language does not include specific requirements for electrical systems on construction documents for commercial construction. Given the importance of the electrical system in a mixed-fuel building, including an explicit requirement in the construction documents will allow for easier implementation and enforcement of the requirements on code compliance plan review staff.

C105 INSPECTIONS

Revise 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. Where a storage-ready zone is required, inspections shall verify space availability and pathways to electrical service.

Chapter 2 – Definitions

C202 GENERAL DEFINITIONS

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.

Definition of appliance is mirrored from 2021 IMC to be useful in defining combustion equipment.

> **AUTOMATIC LOAD MANAGEMENT SYSTEMS (ALMS).** A control system that allows multiple connected *EVSE* to share a circuit or panel and automatically reduce power at each charger, reducing the total connected electrical capacity of all *EVSE*.
>
> **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 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.

Definition of commercial cooking appliances is mirrored from the 2021 International Fire Code for use in defining requirements for additional electric infrastructure required for cooking under Section C405.14.3.

DEMAND RESPONSIVE CONTROL. An automatic control that can receive and automatically respond to demand response requests from a utility, electrical system operator, or third-party demand response program provider.

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current. Plug-in hybrid electric vehicles are electric vehicles having a second source of motive power. Off-road, self-propelled electric mobile equipment, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats and the like, are not considered electric vehicles.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE). The conductors, including the ungrounded, grounded, and equipment grounding conductors and the *electric vehicle* connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for the purpose of transferring energy between the premises wiring and the *electric vehicle*.

Definitions for EV and EVSE are mirrored from NEC-2020 to be useful in defining requirements for electric vehicle infrastructure.

ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE) SPACE. A designated parking space with dedicated *electric vehicle supply equipment* capable of supplying not less than 6.2 kW to an *electric vehicle* located within 3 feet (914 mm) of the parking space.

The charging rate for an EVSE space is set at 6.2 kW. This is equivalent to a 30A/208V EVSE. 30 and 32A chargers are the most common Level 2 chargers and the highest capacity chargers that can be installed on a 40A branch circuit. kW is used as the metric to indicate total power delivered rather than the specific combination of Volts and Amps.

EQUIPMENT. Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

Definition of equipment is mirrored from 2021 IMC to be useful in defining combustion equipment.

EV-CAPABLE SPACE. A parking space that is provided with conduit that meets the following requirements:

1. The conduit shall be continuous between a junction box or receptacle located within 3 feet (914 mm) of the parking space and an electrical panel serving the area of the parking space with sufficient dedicated physical space for a dual-pole, 40-amp breaker
2. The conduit shall be sized and rated to accommodate a 40-amp, 208/240-volt branch circuit and have a minimum nominal trade size of 1 inch
3. The electrical junction box and the electrical panel directory entry for the dedicated space in the electrical panel shall have labels stating "For future *electric vehicle* charging"

EV-READY SPACE. A parking space that is provided with dedicated branch circuit that meets the following requirements:

1. Wiring capable of supporting a 40-amp, 208/240-volt circuit,
2. Terminates at a junction box or receptacle located within 3 feet (914 mm) of the parking space, and
3. The electrical panel directory shall designate the branch circuit as "For electric vehicle charging" and the junction box or receptacle shall be labelled "For electric vehicle charging".

EV Ready and EV Capable definitions do not include requirements for minimum capacity for the branch circuit. Different levels of capacity are appropriate for different EV charging scenarios (charging at different building types, parking types, residential types, business types, times of day, etc.) as well as different levels of penetration of EV charging spaces in a parking lot. Therefore, capacity requirements are set in the code text itself to allow for consistent use of the definitions while the capacity requirements change to match the specific EVCI requirements of the jurisdiction.

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

Definition of fuel gas is mirrored from 2021 IMC to be useful in defining combustion equipment.

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

Definition of fuel oil is mirrored from 2021 IMC to be useful in defining combustion equipment.

MIXED-FUEL BUILDING. A *building* that contains *combustion equipment* or includes piping for such *equipment*.

RENEWABLE ENERGY CERTIFICATE (REC). An instrument that represents the environmental attributes of one megawatt-hour of renewable electricity; also known as an energy attribute certificate (EAC).

Chapter 4 – Commercial Energy Efficiency

C402 BUILDING ENVELOPE REQUIREMENTS

Revise text as follows:

C402.1.1 Low energy buildings and greenhouses. The following low-energy buildings, or portions thereof separated from the remainder of the *building*-by-*building thermal*

envelope assemblies complying with this section shall be exempt from the building thermal envelope provisions of Section C402.

1. Those containing no *combustion equipment* with a peak design rate of energy usage less than 3.4 Btu/h·ft2 (10.7 W/m2) or 1.0 watt/ft2 of floor area for space conditioning purposes.

C402.1.1.1 Greenhouses. Greenhouse structures or areas containing no *combustion equipment* that are mechanically heated or cooled and that comply with all of the following shall be exempt from the building envelope requirements of this code:

C402.1.2 Equipment buildings. Buildings that comply with the following shall be exempt from the *building thermal envelope* provisions of this code:

6. Contain no *combustion equipment*.

Low energy buildings are currently exempt from thermal envelope requirements. This revision applies the same intention of low greenhouse gas impact that was given to low energy use impact when these building types were exempted.

C403 BUILDING MECHANICAL SYSTEMS

Add new text as follows:

C403.4.1.6 Demand responsive thermostats. All thermostats shall be provided with *demand responsive controls* capable of increasing the cooling setpoint by no less than 4°F (2.2°C) and decreasing the heating setpoint by no less than 4°F (2.2°C).

Exception: Health care and assisted living facilities.

Demand responsive controls for thermostats are added based on language from California Title 24. In health care and assisted living facilities, thermostat setpoints can impact more than just thermal comfort, and temperature can be part of the health care being provided. To ensure that this requirement cannot have an adverse impact on those services, these facilities have been exempted from this requirement.

C404 SERVICE WATER HEATING

Revise text as follows:

C404.2.1 High input service water-heating systems. Gas-fired water-heating equipment installed in new buildings shall be in compliance with this section. Where a singular piece of water-heating equipment serves the entire building and the input rating of the equipment is 1,000,000 Btu/h (293 kW) or greater, such equipment shall have a thermal efficiency, Et, of not less than 92 percent or a UEF of not less than 0.92 UEF. Where multiple pieces of water-heating equipment serve the building and the combined input rating of the water-heating equipment is 1,000,000 Btu/h (293 kW) or greater, the

combined input-capacity-weighted-average thermal efficiency, Et, of not less than ~~90~~92 percent or a UEF of not less than 0.92 UEF.

Exceptions:

1. Where not less than ~~25~~50 percent of the annual *service water heating* requirement is provided by *on-site renewable energy* or site-recovered energy not including any capacity used for compliance with Section C405.13 or C406 of this code, the minimum thermal efficiency requirements of this section shall not apply.
2. The input rating of water heaters installed in individual dwelling units shall not be required to be included in the total input rating of *service water-heating* equipment for a building.
3. ~~The input rating of water heaters with an input rating of not greater than 100,000 Btu/h (29.3 kW) shall not be required to be included in the total input rating of *service water-heating* equipment for a building.~~

Revisions to Section C404.2 in 2021 IECC raised the high-capacity service hot water efficiency requirement from 0.90 Et to 0.92 but did not add specifications for measurement with UEF as was done in the IgCC. This section adds UEF. While some combinations of boilers with a combined capacity above 1,000,000 Btu/h always triggered the requirement, this modification removes the exemption for multiple smaller water heaters or boilers unless they are located in individual dwelling units.

Add new text as follows:

C404.11 Demand responsive water heating. All electric water heating systems with a storage tank larger than 20 gallons (76 L) shall be provided with *demand responsive controls* that comply with ANSI/CTA-2045-B or another *approved demand responsive control*.

Exception: Health care facilities.

ANSI/CTA-2045-B standardizes the socket, and communications protocol, for heat pump water heaters so they can communicate with the grid, and with demand response signal providers. In addition, 2045-B adds control and communications requirements for mixing valves in HPWH to enable them to provide greater storage capacity to support increased load shifting. Versions of this standard are included in codes or other requirements in California, Oregon, and Washington

In health care facilities, such as hospitals, nursing facilities, and outpatient facilities, hot water can be critical to support the care being provided. To ensure that this requirement cannot have an adverse impact on those services, health care facilities have been exempted from this requirement.

C405 ELECTRICAL POWER AND LIGHTING SYSTEMS

Add new text as follows:

C405.2 Lighting controls. Lighting systems shall be provided with controls that comply with one of the following.

2. Luminaire level lighting controls (LLLC) and lighting controls as specified in Sections C405.2.1, C405.2.4 and C405.2.5. The LLLC luminaire shall be independently capable of:
   2.4 Reducing lighting power in a uniform manner by no less than 10 percent when signaled by a *demand responsive control*.

This approach to DR controls for lighting limits the requirement to LLLC lighting, which uses control technology that generally already includes DR functionality or for which DR functionality comes at a minimal additional cost. The threshold for lighting power reduction is drawn from California's T24 DR requirements.

Revise table as follows:

TABLE C405.12.2 ENERGY USE CATEGORIES

LOAD CATEGORY	DESCRIPTION OF ENERGY CUSE
Total HVAC system	Heating, cooling and ventilation, including but not limited to fans, pumps, boilers, chillers, and water heating. Energy used by 120-volt equipment, or by 208/120-volt equipment that is located in a building where the main service is 480/277-volt power, is permitted to be excluded from total HVAC system energy use.
Interior lighting	Lighting systems located within the building.
Exterior lighting	Lighting systems located on the building site but not within the building.
Plug loads	Devices, appliances and equipment connected to convenience receptacle outlets.
Process load	Any single load that is not included in HVAC, lighting or plug load category and that exceeds 5 percent of the peak connected load of the whole building, including but not limited to data centers, manufacturing equipment, and commercial kitchens.
Electric vehicle charging	*Electric vehicle* charging loads.
Building operations and other miscellaneous	The remaining loads not included in this table, including but not limited to vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains, ornamental fireplaces, swimming pools, in-ground spas and snow-melt systems.

Electric Vehicle charging is a transportation load, not a building load, but is often provided through a building electrical service connection. Adding a category for monitoring EV charging separately allows the building load to be measured independently from this non-building load. This will be critical with the wider adoption of Building Performance Standards or other existing building energy use policies as it will allow EV charging to be easily excluded from the building loads for the purposes of regulating actual energy use in buildings.

Add new text as follows:

C405.13 On site renewable energy. Each building site shall have equipment for on-site renewable energy with a rated capacity of not less than 0.25 W/ft² (2.7 W/m²) multiplied by the sum of the gross conditioned floor area of the three largest floors.

Exceptions:

1. Any building located where an unshaded flat plate collector oriented towards the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 3.5 kWh/m²·day (1.1 kBtu/ft²·day).

2. Any building where more than 80 percent of the roof area is covered by any combination of equipment other than for on-site renewable energy systems, planters, vegetated space, skylights, or occupied roof deck.

3. Any building where more than 50 percent of roof area is shaded from direct-beam sunlight by natural objects or by structures that are not part of the building for more than 2,500 annual hours between 8:00 AM and 4:00 PM.

C405.13.1 Renewable energy certificate documentation. Documentation shall be provided to the code official that indicates that renewable energy certificates (RECs) associated with the on-site renewable energy will be retained and retired by or on behalf of the owner or tenant.

A version of this requirement has been approved for ASHRAE 90.1-2019 as Addendum by,[5] and will be published in ASHRAE 90.1-2022. The three exceptions are written to ensure that the requirement is not being applied to buildings without adequate space on the roof, to buildings that are in areas of the country where unblocked insolation levels do not provide enough energy to make the equipment cost-effective (according to ASHRAE cost-effective criteria), and to buildings where solar access is wholly or partially blocked.

Add new text as follows:

C405.14 Electric vehicle charging infrastructure. Parking facilities shall be provided with electric vehicle charging infrastructure in accordance with Table C405.14 based on the total number of parking spaces and rounded up to the nearest whole number. Where more than one parking facility is provided on a building site, the number of parking spaces required shall be calculated separately for each parking facility. The branch circuit serving *EV ready spaces* shall have a minimum capacity of 1.8 kVA. *EVSE*, *EV ready spaces* and *EV capable spaces* may be counted toward meeting minimum parking requirements. *EVSE spaces* may be used to meet requirements for *EV ready spaces* and *EV capable spaces*. *EV ready spaces* may be used to meet requirements for *EV capable spaces*. An *ALMS* may be used to reduce the total electrical capacity

[5] Addendum by to ASHRAE 90.1-2019 is posted at https://www.ashrae.org/file%20library/technical%20resources/standards%20and%20guidelines/standards%20addenda/90_1_2019_by_ck_cp_20200731.pdf

required by *EVSE spaces* provided that all *EVSE spaces* are capable of simultaneously charging at a minimum rate of 1.4 kW.

Exception: In parking garages, the conduit required for *EV capable spaces* may be omitted provided the parking garage electrical service has no less than 1.8 kVA of additional reserved capacity per *EV capable space.*

The EV charging infrastructure requirements have been tailored to different charging scenarios. EV Ready spaces are utilized in residential occupancies where EV owners are more likely to choose specific EVSEs with features that meet their personal, long-term needs. The minimum capacity of those EV Ready spaces has been set at Level 1 charging in order to maximize access to EV charging:

4. *Residential park times are generally much longer which makes Level 1 charging more feasible.*
5. *All EVs come with at least a Level 1 charger, eliminating the need for EV owners to invest in additional equipment to charge at their homes.*
6. *Level 1 charging minimizes the cost of enabling EV charging at a parking space, allowing for the maximization of the number of EV spaces, which maximizes access to charging.*

EVSE spaces are required for commercial parking lots where shorter parking times are typical and Level 2 or 3 parking is more appropriate. Additionally, while the car connection side of Level 2 EVSE are standard, the grid connection side is not, so utilizing EVSE rather than EV Ready spaces maximizes the utility of parking spaces in commercial lots that have more transient parking.

This EVCI language is based on the approach used in the electrification reach codes adopted by various California cities. It captures recent developments in the national conversation about the best way to bring EVCI requirements to code in a way that is consistent, understandable, feasible and ensures the societal benefit of the widest penetration of EV charging possible.

The exception is added to allow capacity to be substituted for conduit in parking garages. EVCI retrofits have different cost considerations in parking garages compared to surface parking lots. Parking garage retrofits do not require retrenching, so the conduit in EV capable spaces does not come with the same future avoided costs.

TABLE C405.14
ELECTRIC VEHICLE CHARGING INFRASTRUCTURE REQUIREMENTS

OCCUPANCY	***EVSE SPACES***	***EV READY SPACES***	***EV CAPABLE SPACES***
Group B Occupancies	15%	NA	40%
Group M Occupancies	25%	NA	40%
R-2 Occupancy	NA	100%[a]	NA
All other Occupancies	10%	NA	40%

a. Or one *EV ready space* per *dwelling unit.*

The percentages in Table C405.14 can be adjusted to tailor the requirements for the specific market needs of a jurisdiction. However, the EV Capable space requirements included for all commercial lots

recognizes that future needs for EV charging will be much greater than they are now. EV capable spaces avoid the significant cost of parking lot re-trenching, which is one of the largest single costs of EVCI retrofits but only a minor investment in new construction.

Add new text as follows:

C405.15 Electric infrastructure for energy storage. Each building site shall have equipment for on-site energy storage not less than 2 feet (610 mm) in one dimension and 4 feet (1219 mm) in another dimension and located in accordance with Section 1206.2.8 of the International Fire Code and Section110.26 of the NFPA 70.

Exception: Where an onsite electrical energy system storage system is installed.

C405.15.1 Electrical service reserved space. The main electrical service panel shall have a reserved space to allow installation of a two-pole circuit breaker for future electrical energy storage system installation This space shall be labeled "For Future Electric Storage." The reserved spaces shall be positioned at the end of the panel that is opposite from the panel supply conductor connection.

Infrastructure for energy storage has been migrated up from Appendix CB Solar-Ready Zone into the main body of the code. This language includes revisions from the 2019 Group B Public Comment that were not incorporated into the final text of the 2021 IECC but modify the language to ensure needed correlation with the IFC and NFPA.

Add new text as follows:

C405.16 Additional electric infrastructure. All *combustion equipment* and end-uses shall be installed in accordance with this section.

The following sections ensure that gas equipment can be more easily and cost-effectively retrofit with electric equipment in the future. This language is adapted from the approach adopted in the electrification reach codes adopted by various California cities. It combines the best elements from those reach codes and adapts them to the I-Code format.

C405.16.1 Electric infrastructure for dwelling and sleeping units. *Combustion equipment* and end-uses serving individual *dwelling units* or *sleeping units* shall comply with Section R404.6.

C405.16.2 Combustion water heating equipment. Gas-fired water heaters with a capacity less than 300,000 Btu/h (88 kW) shall be installed in accordance with the following:

1. A dedicated 208/240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 3 feet (914 mm) from the water heater and be accessible to the water heater with no obstructions. Both ends of the branch circuit shall be labeled with the words "For Future Heat Pump Water Heater" and be electrically isolated,

2. A condensate drain that is no more than 2 inches (51 mm) higher than the base of the installed water heater and allows natural draining without pump assistance shall be installed within 3 feet (914 mm) of the water heater,
3. The water heater shall be installed in a space with minimum dimensions of 3 feet (914 mm) by 3 feet (914 mm) by 7 feet (2134 mm) high, and
4. The water heater shall be installed in a space with a minimum volume of 700 cubic feet (20,000 L) or the equivalent of 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.

Section C405.16.2 includes a size threshold so that it only applies to smaller, unitary water heaters. It provides a series of requirements that ensure that the building can accommodate a HPWH in the future. Requirement 1 ensures that there is a branch circuit ready to support the future installation of a HPWH. Requirement 2 ensures that the condensate generated by a HPWH compressor can be easily drained away. Requirement 3 ensures that the water heater location is physically large enough to accommodate HPWHs that are frequently wider and/or taller than code-minimum gas water heaters. Requirement 4 ensures that a future HPWH has access to sufficient air volume to effectively operate.

C405.16.3 Combustion cooking equipment. *Commercial cooking appliances* shall be provided with a dedicated branch circuit with a minimum capacity of 12 kVA per 1 kBtu of appliance input capacity. The branch circuit shall terminate within 3 feet (914 mm) of the 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.

The addition of C405.16.3 establishes a sizing equivalency based on the input of standard commercial range gas burners and electric hobs. If the requirements of this provision would be too difficult for a jurisdiction’s particular market, the elimination of this section would put commercial gas cooking equipment under C405.16.4 Other combustion equipment (which would need to be re-numbered), which does not include full circuits or panel capacity for that equipment.

C405.16.4 Other combustion equipment. *Combustion equipment* not covered by Sections C405.16.2-3 shall be provided with conduit that is continuous between a junction box located within 3 feet (914 mm) of the *appliance* or *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 appliance, equipment or end use with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, “For future electric equipment”.

The addition of C405.16.4 includes requirements to improve the feasibility of future electrification retrofits. The requirements ensure that adding future electric branch circuits is relatively simple. The section does not include any requirements for branch circuits or electrical panel capacity since it addresses equipment that may be quite large or for which the electric infrastructure needs of future electric equivalent may be uncertain, including heating systems and loads.

C406 ADDITIONAL EFFICIENCY REQUIREMENTS

Revise text as follows:

C406.1 Additional energy efficiency credit requirements. New *all-electric buildings* shall achieve a total of 10 credits and new *mixed-fuel buildings* shall achieve a total of 15 credits from Tables C406.1(1) through C406.1(5) where the table is selected based on the use group of the building and from credit calculations as specified in relevant subsections of C406. Where a building contains multiple use groups, credits from each use group shall be weighted by floor area of each group to determine the weighted average building credit. Credits from the tables or calculation shall be achieved where a building complies with one or more of the following:

To encourage electrification of buildings while allowing for mixed-fuel construction, mixed fuel buildings are required to achieve more efficiency credits. Where a mixed fuel building is constructed under this overlay, these provisions will decrease its carbon impact.

Revise text as follows:

C406.5 Onsite renewable energy. The total minimum ratings of on-site renewable energy systems, not including onsite renewable energy system capacity used for compliance with Section C405.13, shall be one of the following:

With the addition of C405.13 for mandatory inclusion of onsite renewable energy this section is revised to allow only additional renewable energy to be counted toward compliance with the additional efficiency requirements.

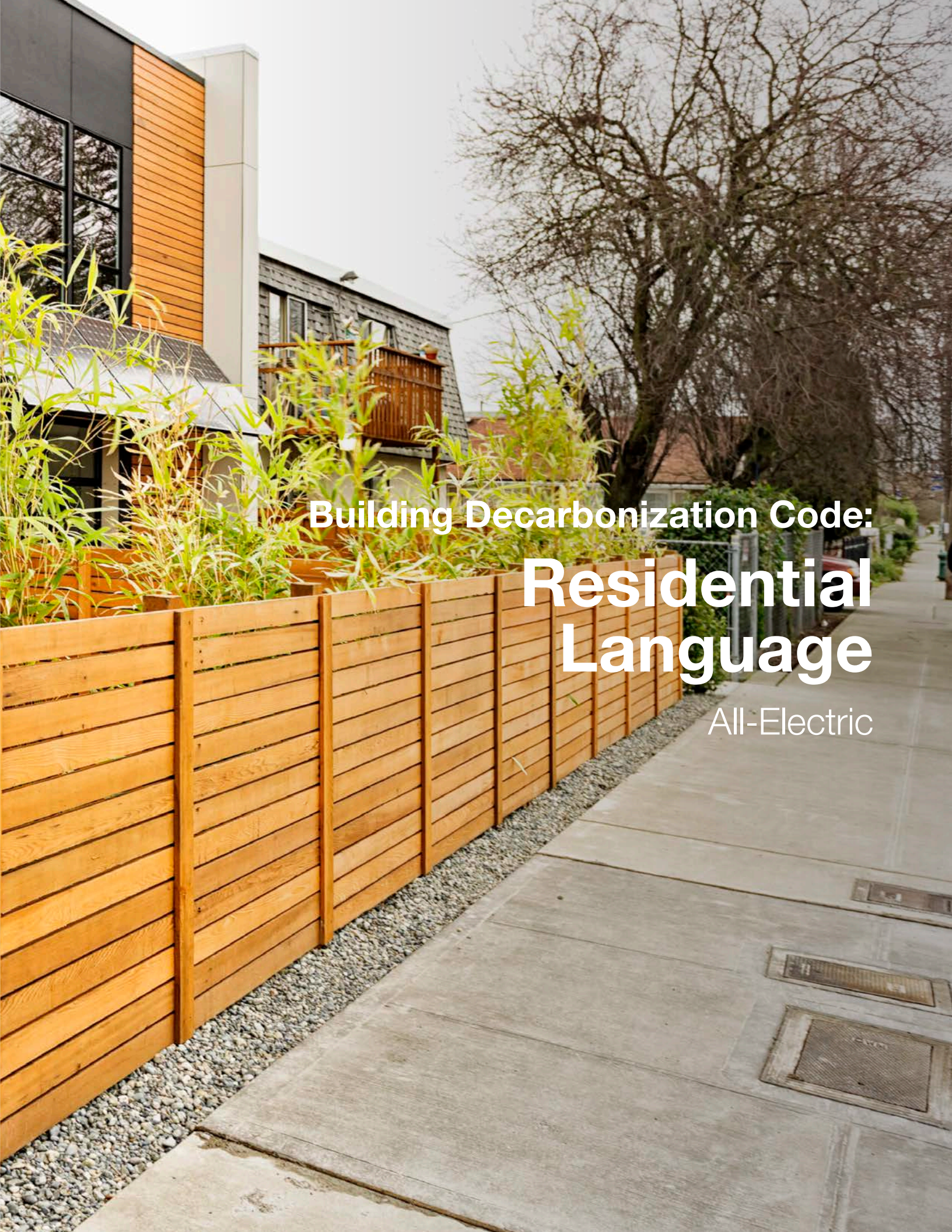
Chapter 6 – Referenced Standards

Add new standard as follows:

CTA

Consumer Technology Association
1919 S. Eads Street
Arlington, VA 22202

Standard reference number	Title	Referenced in code section number
ANSI/CTA-2045-B	Modular Communications Interface for Energy Management	C404.11



Building Decarbonization Code:

Residential Language

All-Electric

IECC - Residential Provisions (All-Electric)

Chapter 1 – Scope and Application

R101 SCOPE AND GENERAL REQUIREMENTS

Revise text as follows:

> **R101.3 Intent.** This code shall regulate the design, and construction of buildings for the ~~effective use and conservation~~ reduction of greenhouse gas emissions and for the efficient production, use and storage of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Intent has been modified to include consideration of greenhouse gas emissions as well as both production and storage of energy.

R103 CONSTRUCTION DOCUMENTS

Add new text as follows:

> **R103.2.3 Solar-ready system**. The construction documents shall provide details for dedicated roof area, structural design for roof dead and live load, and routing of conduit or pre-wiring from *solar-ready zone* to electrical service panel or plumbing from *solar-ready zone* to *service water heating* system for the *solar-ready zone* shall be represented on the construction documents.

Revisions to this section incorporate critical elements of solar readiness to be clearly identified on the construction documents to allow for easier code compliance review and inspections. This code language has been migrated and amended from the 2021 IECC Appendix RB Solar-Ready Provisions to the most appropriate place in the base code.

R105 INSPECTIONS

Revise text as follows:

> **R105.2.3 Plumbing rough-in inspection.** Inspections at plumbing rough-in shall verify compliance as required by the code and approved plans and specifications as to types of insulation and corresponding R-values and protection and required controls. Where the solar-ready zone is installed for solar water heating, inspections shall verify pathways for routing of plumbing from solar-ready zone to service water heating system.

Revisions to this section incorporate critical elements of solar readiness used for service water heating to allow for inspection enforcement of this provision. This code language is not in the current version of the 2021 IECC Appendix RB Solar-Ready Provisions but is derived from the that language to fully incorporate all aspects of that appendix throughout the base code for enforceability by adopting jurisdictions.

Add new text as follows:

> **R105.2.5 Electrical rough-in inspection.** Inspections at electrical rough-in shall verify compliance as required by the code and the approved plans and specifications as to the locations, distribution, and capacity of the electrical system. Where the solar-ready zone is installed for electricity generation, inspections shall verify conduit or pre-wiring from solar-ready zone to electrical panel.

Current 2021 IECC inspections do not require dedicated electrical inspections. Additional electrical inspection code language that is not in the current version of the 2021 IECC Appendix RB Solar-Ready Provisions but is derived from the that language to fully incorporate all aspects of that appendix throughout the base code for enforceability by adopting jurisdictions.

Revise numbering as follows:

> ~~**R105.2.5**~~ **R105.2.6 Final inspection.**

Chapter 2 – Definitions

R202 GENERAL DEFINITIONS

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.

Definition for appliance is mirrored from 2021 IMC to be useful in defining combustion equipment.

> **COMBUSTION EQUIPMENT.** Any *equipment* or *appliance* used for space heating, *service water heating*, cooking, clothes drying, or lighting that uses *fuel gas* or *fuel oil*.
>
> **DEMAND RESPONSIVE CONTROL.** An automatic control that can receive and automatically respond to demand response requests from a utility, electrical system operator, or third-party demand response program provider.
>
> **ELECTRIC VEHICLE (EV).** An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current. Plug-in hybrid electric vehicles are electric vehicles having a second source of motive power. Off-road, self-propelled electric mobile equipment, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats and the like, are not considered electric vehicles.

Definition for EV is mirrored from NEC-2020 to be useful in defining requirements for electric vehicle infrastructure.

EQUIPMENT. Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

Definition for equipment is mirrored from 2021 IMC to be useful in defining combustion equipment.

EV-READY SPACE. A parking space that is provided with dedicated branch circuit that meets the following requirements:

1. Wiring capable of supporting a 40-amp, 208/240-volt circuit,
2. Terminates at a junction box or receptacle located within 3 feet (914 mm) of the parking space, and
3. The electrical panel directory shall designate the branch circuit as "For electric vehicle charging" and the junction box or receptacle shall be labelled "For electric vehicle charging".

The definition for EV Ready does not include requirements for minimum capacity for the branch circuit. Different levels of capacity are appropriate for different EV charging scenarios (charging at different building types, parking types, residential types, business types, times of day, etc.) as well as different levels of penetration of EV charging spaces in a parking lot. Therefore, capacity requirements are set in the code text itself to allow for consistent use of the definitions while the capacity requirements change to match the specific EVCI requirements of the jurisdiction. The wiring requirement ensures that the space can be upgraded to a load-managed Level 2 EVSE in the future.

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

Definition for fuel gas is mirrored from 2021 IMC to be useful in defining combustion equipment.

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

Definition for fuel oil is mirrored from 2021 IMC to be useful in defining combustion equipment.

MIXED-FUEL BUILDING. A *building* that contains *combustion equipment* or includes piping for *combustion equipment*.

SOLAR-READY ZONE. A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

Definition for solar-ready zone has been migrated from the 2021 IECC Appendix RB Solar-Ready Provisions to the base code.

Chapter 4 – Residential Energy Efficiency

R401 GENERAL

Revise text as follows:

R401.2 Application. Residential buildings shall be *all-electric buildings* and shall comply with Section R401.2.~~5~~4 and either Sections R401.2.1, R401.2.2, or R401.2.3 ~~or R401.2.4~~.

The change in application requires that new construction be all-electric. Where a jurisdiction does not wish to require electrification of specific end uses but wants to advance electric buildings further than electric-readiness, exception language can be added. Where exception language is added, electric infrastructure language should be brought over from the mixed-fuel version of the overlay to ensure easy accessibility to future electric equipment installation. Recommended exception language is: Exception: The following combustion equipment is permitted as approved by the code official (list specific equipment types).

Delete section without substitution:

~~**R401.2.2 Total Building Performance Option.** The Total Building Performance Option requires compliance with Section R405.~~

Revise numbering as follows:

R401.2.~~3~~2 Energy Rating Index Option.

R401.2.4~~3~~ Tropical Climate Region Option.

R401.2.~~5~~4 Additional energy efficiency.

The total building performance option has been removed from the residential compliance path options. See additional reasoning under R405. All other sections have been renumbered to reflect removal of this compliance option.

Revise text as follows:

R401.3 Certificate. A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certification shall indicate the following:

4. The types, sizes, and efficiencies of heating, cooling and service water heating equipment. Where a ~~gas-fired unvented room heater,~~ electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate ~~"gas-fired unvented room heater,"~~ "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be indicated for ~~gas-fired unvented room heaters,~~ electric furnaces and electric baseboard heaters.

8. Where a *solar-ready zone* is provided, the certificate shall indicate the location, dimensions, and capacity reserved on the electrical service panel.

Revisions to this section remove vestigial language around "gas-fired" equipment that will not be necessary in an all-electric code and incorporate critical elements of solar readiness to be clearly identified to the original homeowner/building owner and any subsequent owners to allow for easier installation of solar panels. This code language has been migrated from the 2021 IECC Appendix RB Solar-Ready Provisions to the most appropriate place in the base code. By including on the certificate, the information is more likely to remain in the building for future owners.

R402 BUILDING THERMAL ENVELOPE

Delete section without substitution:

~~**R402.4.4 Rooms containing fuel burning appliances.**~~

All electric buildings will not need language that relates to fossil fuel systems. This vestigial language has been removed to avoid confusion in implementation of this overlay.

R403 SYSTEMS

Revise text as follows:

R403.1.1 Thermostat ~~**Programmable thermostat.**~~ The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature setpoints at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C). The thermostat shall be a d*emand responsive control* capable of increasing the cooling setpoint by no less than 4°F (2.2°C) and decreasing the heating setpoint by no less than 4°F (2.2°C) in response to a demand response request.

Demand responsive controls for thermostats are added based on language from California Title 24 and integrated into the current requirement for thermostats.

Add new text as follows:

R403.5.4 Demand responsive water heating. All electric water heating systems with a storage tank larger than 20 gallons (76 L) shall be provided with *demand responsive controls* that comply with ANSI/CTA-2045-B or another *approved demand responsive control*.

ANSI/CTA-2045-B standardizes the socket, and communications protocol, for heat pump water heaters so they can communicate with the grid, and with demand response signal providers. In addition, 2045-B adds control and communications requirements for mixing valves in HPWH to enable them to provide

greater storage capacity to support increased load shifting. Versions of this standard are included in codes or other requirements in California, Oregon, and Washington.

R404 ELECTRICAL POWER AND LIGHTING SYSTEMS

Revise text as follows:

R404.1.1 Fuel gas lighting equipment. Fuel gas lighting systems shall not ~~have continuously burning pilot lights~~ be installed.

While the use of gas lighting is nearly extinct for both indoor and outdoor new construction uses, gas lamps remain a nostalgic feature in historic neighborhoods. Since the IRC Chapter 24 Fuel Gas does not prohibit the installation of fuel gas lighting, it is critical to ensure that the adoption of this overlay does prohibit these installations.

Add new text as follows:

R404.4 Renewable energy infrastructure. The building shall comply with the requirements of R404.4.1 or R404.4.2

This code language has been migrated from the 2021 IECC Appendix RB Solar-Ready Provisions to the most appropriate place in the base code. By ensuring solar-ready zones, all-electric buildings will have the potential for an even greater impact on building decarbonization by contributing to the continued cleaning of the electricity supply.

R404.4.1 One- and two- family dwellings and townhouses. One- and two-family dwellings and townhouses shall comply with Sections R404.4.1.1 through R404.4.1.4.

Exceptions:

1. A *building* with a permanently installed on-site renewable energy system.

2. A *building* with a solar-ready zone area that is less than 600 square feet (55 m^2) of roof area oriented between 110 degrees and 270 degrees of true north.

3. A *building* with a solar-ready zone area that is shaded for more than 70 percent of daylight hours annually.

R404.4.1.1 Solar-ready zone area. The total solar-ready zone area shall be not less than 300 square feet (28 m^2) exclusive of mandatory access or set back areas as required by the International Fire Code. Townhouses three stories or less in height above grade plane and with a total floor area less than or equal to 2,000 square feet (186 m^2) per dwelling shall have a solar-ready zone area of not less than 150 square feet (14 m^2). The solar-ready zone shall be composed of areas not less than 5 feet (1524 mm) in width and not less than 80 square feet (7.4 m^2) exclusive of access or set back areas as required by the International Fire Code.

R404.4.1.2 Obstructions. Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

R404.4.1.3 Electrical service reserved space. The main electrical service panel shall have a reserved space to allow installation of a dual pole circuit breaker for future solar electric installation and shall be labeled "For Future Solar Electric." The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location.

R404.4.1.4 Electrical interconnection. An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the *solar ready zone* by one of the following:

1. Minimum ¾-inch nonflexible conduit
2. Minimum #10 Metal copper 3-wire

Where the interconnection terminates in the attic, location shall be no less than 12" (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled "For Future Solar Electric".

As it is currently written, Appendix RB only requires that the construction documents indicate pathways for routing of conduit from the solar-ready zone to the service panel. This update requires the installation and verification of either conduit or wire from the roof or attic to the panel. This language has been adapted from the solar-ready language proposed for the residential Oregon Reach Code.

R404.4.1 Group R occupancies. Buildings in Group R-2, R-3 and R-4 shall comply with Section C405.13.

The 2021 IECC Appendix RB Solar-Ready Provisions address single and two-family dwellings only. Additional language is added to apply the approach for commercial buildings to multifamily residential construction.

Add new text as follows:

R404.5 Electric vehicle charging infrastructure. Electric infrastructure for the current and future charging of *electric vehicles* shall be installed in accordance with this section. *EV ready spaces* are permitted to be counted toward meeting minimum parking requirements.

R404.5.1 One- and two- family dwellings and townhouses. One- and two-family dwellings and townhouses with a dedicated attached or detached garage or on-site parking spaces and new detached garages shall be provided with one *EV-ready space* per *dwelling unit.* The branch circuit for the *EV ready space* shall have a minimum capacity of 9.6 kVA.

R404.5.2 Group R occupancies. Parking facilities serving Group R-2, R-3 and R-4 occupancies shall comply with Section C405.15.

Tailored requirements for single-family and multifamily housing have been included. Single-family homes, where the occupants will choose the specific EVSE that meets their EV charging needs, are

required to have one parking space with an EV Ready space that is sized to accommodate the most common EVSE on the market. The requirements for EV charging infrastructure for multifamily buildings are referenced to the commercial requirements as those are more appropriate for EV charging in parking lots. The required capacity for the branch circuit for the EV Ready space is the equivalent of a 240V, 40A circuit and is expressed in kVA as that is the standard metric for capacity or "apparent power" in electrical infrastructure.

SECTION 405 TOTAL BUILDING PERFORMANCE

Delete without substitution:

~~**R405 Total Building Performance**~~

Compliance with the performance path for consideration of greenhouse gas emissions and the needed increased stringency for mixed-fuel buildings requires manipulation of the standard reference design for space heating, water heating, and any other potential combustion end use. Given the limited application of Section R405 in new residential construction, for the purposes of this overlay, compliance via prescriptive path or ERI path create simpler enforcement options for jurisdictions.

SECTION 406 ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

Revise table as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION	TITLE
Mechanical	
R403.5 except Section R403.5.2	Service hot water systems
~~R403.5.1~~	~~Heated water circulation and temperature maintenance systems~~
~~R403.5.3~~	~~Drain water heat recovery units~~

The ERI mandatory requirements table has been modified to include the new requirement for demand responsive hot water control. Based on the structure of the table currently, combining R403.5 and creating a single in line exception is the most straightforward approach to this revision.

Revise table as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION	TITLE
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.4	Renewable energy infrastructure
R404.5	Electric vehicle charging infrastructure
R406.3	Building thermal envelope

The ERI mandatory requirements table has been modified to include the new requirements for renewable energy and electric vehicle charging as mandatory elements of the code amendments.

R407 TROPICAL CLIMATE REGION COMPLIANCE PATH

Revise text as follows:

R407.2 Tropical climate region. Compliance with this section requires the following:

1. Not more than one-half of the *occupied* space is air conditioned and is controlled by a thermostat in accordance with Section R403.1.1.

3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating controlled in accordance with Section R403.5.4.

12. Parking is in accordance with Section R404.6.

Modifications to the Tropical Climate Region Path are minimal. This pathway in the 2021 IECC already does not allow any space heating and requires 80% of hot water be supplied by renewable energy. To ensure the inclusion of demand response controls, electric vehicles, and all other combustion equipment is addressed additional requirements are added to the tropical compliance list under R407.2.

R408 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Revise text as follows:

R408.2.2 More efficient HVAC equipment. Heating and cooling *equipment* shall meet one of the following efficiencies:

~~1. Greater than or equal to 95 AFUE natural gas furnace and 16 SEER air conditioner.~~

~~2~~1. Greater than or equal to 10 HSPF/16 SEER air source heat pump.

~~3~~2. Greater than or equal to 3.5 COP ground source heat pump.

R408.2.3 Reduced energy use in service water-heating option. The hot water system shall meet one of the following efficiencies:

~~1. Greater than or equal to 82 EF fossil fuel service water-heating system.~~

~~2~~1. Greater than or equal to 2.0 EF electric service water-heating system.

~~3~~2. Greater than or equal to 0.4 solar fraction solar water-heating system.

All electric buildings will not need language that relates to fossil fuel systems. This vestigial language has been removed to avoid confusion in implementation of this overlay and the sections have been renumbered.

Chapter 6 – Referenced Standards

Add new standard as follows:

CTA Consumer Technology Association
1919 S. Eads Street
Arlington, VA 22202

Standard reference number	Title	Referenced in code section number
ANSI/CTA-2045-B	Modular Communications Interface for Energy Management	R403.5.4

Building Decarbonization Code:

Residential Language

Mixed-Fuel

IECC - Residential Provisions (Mixed-Fuel)

Chapter 1 – Scope and Application

R101 SCOPE AND GENERAL REQUIREMENTS

Revise text as follows:

> **R101.3 Intent.** This code shall regulate the design, and construction of buildings for the ~~effective use and conservation~~ reduction of greenhouse gas emissions and for the efficient production, use and storage of energy over the useful life of each building. This code is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve this objective. This code is not intended to abridge safety, health or environmental requirements contained in other applicable codes or ordinances.

Intent has been modified to include consideration of greenhouse gas emissions as well as both production and storage of energy.

R103 CONSTRUCTION DOCUMENTS

Revise text as follows:

> **R103.2 Information on construction documents.** Construction documents shall be drawn to scale upon suitable material. Electronic media documented are permitted to be submitted when approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed, and show in sufficient detail pertinent data and features of the building, systems and equipment herein governed. Details shall include the following as applicable:
>
> > 6. Mechanical and service water heating systems and equipment types, sizes, fuel sources and efficiencies.

Fuel sources are a critical piece of code compliance enforcement for the full implementation of this code overlay. Clear identification on the construction documents will allow for easier code compliance review and inspections. Inclusion of fuel sources is most critical in areas where there are multiple fuels available such as fuel oil, propane, and natural gas, as the equipment type alone may not provide this information.

Add new text as follows:

> **R103.2.3 Solar-ready system**. The construction documents shall provide details for dedicated roof area, structural design for roof dead and live load, and routing of conduit or pre-wiring from *solar-ready zone* to electrical service panel or plumbing from *solar-ready zone* to *service water heating* system for the *solar-ready zone* shall be represented on the construction documents.

Revisions to this section incorporate critical elements of solar readiness to be clearly identified on the construction documents to allow for easier code compliance review and inspections. This code language

has been migrated and amended from the 2021 IECC Appendix RB Solar-Ready Provisions to the most appropriate place in the base code.

Add new text as follows:

> **R103.2.4 Electrification system.** The construction documents shall provide details for additional electric infrastructure, including branch circuits, conduit, or pre-wiring, and panel capacity in compliance with the provisions of this code.

Current 2021 IECC language does not include specific requirements for electrical systems on construction documents for residential construction. Given the importance of the electrical system in a mixed-fuel building, including an explicit requirement in the construction documents will allow for easier implementation and enforcement of the requirements on code compliance plan review staff.

R105 INSPECTIONS

Revise text as follows:

> **R105.2.3 Plumbing rough-in inspection.** Inspections at plumbing rough-in shall verify compliance as required by the code and approved plans and specifications as to types of insulation and corresponding R-values and protection and required controls. Where the solar-ready zone is installed for solar water heating, inspections shall verify pathways for routing of plumbing from solar-ready zone to service water heating system.

Revisions to this section incorporate critical elements of solar readiness used for service water heating to allow for inspection enforcement of this provision. This code language is not in the current version of the 2021 IECC Appendix RB Solar-Ready Provisions but is derived from the that language to fully incorporate all aspects of that appendix throughout the base code for enforceability by adopting jurisdictions.

Add new text as follows:

> **R105.2.5 Electrical rough-in inspection.** Inspections at electrical rough-in shall verify compliance as required by the code and the approved plans and specifications as to the locations, distribution, and capacity of the electrical system. Where the solar-ready zone is installed for electricity generation, inspections shall verify conduit or pre-wiring from solar-ready zone to electrical panel.

Current 2021 IECC inspections do not require dedicated electrical inspections. Additional electrical inspection code language that is not in the current version of the 2021 IECC Appendix RB Solar-Ready Provisions but is derived from the that language to fully incorporate all aspects of that appendix throughout the base code for enforceability by adopting jurisdictions.

Revise numbering as follows:

> ~~**R105.2.5**~~ **R105.2.6 Final inspection.**

Chapter 2 – Definitions

R202 GENERAL DEFINITIONS

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.

Definition for appliance is mirrored from 2021 IMC to be useful in defining combustion equipment.

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

DEMAND RESPONSIVE CONTROL. An automatic control that can receive and automatically respond to demand response requests from a utility, electrical system operator, or third-party demand response program provider.

ELECTRIC VEHICLE (EV). An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, electric motorcycles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, a fuel cell, a photovoltaic array, or another source of electric current. Plug-in hybrid electric vehicles are electric vehicles having a second source of motive power. Off-road, self-propelled electric mobile equipment, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats and the like, are not considered electric vehicles.

Definition for EV is mirrored from NEC-2020 to be useful in defining requirements for electric vehicle infrastructure.

EQUIPMENT. Piping, ducts, vents, control devices and other components of systems other than appliances that are permanently installed and integrated to provide control of environmental conditions for buildings. This definition shall also include other systems specifically regulated in this code.

Definition for equipment is mirrored from 2021 IMC to be useful in defining combustion equipment.

EV-READY SPACE. A parking space that is provided with dedicated branch circuit that meets the following requirements:

1. Wiring capable of supporting a 40-amp, 208/240-volt circuit,
2. Terminates at a junction box or receptacle located within 3 feet (914 mm) of the parking space, and
3. The electrical panel directory shall designate the branch circuit as “For electric vehicle charging” and the junction box or receptacle shall be labelled “For electric vehicle charging”.

The definition for EV Ready does not include requirements for minimum capacity for the branch circuit. Different levels of capacity are appropriate for different EV charging scenarios (charging at different building types, parking types, residential types, business types, times of day, etc.) as well as different levels of penetration of EV charging spaces in a parking lot. Therefore, capacity requirements are set in

the code text itself to allow for consistent use of the definitions while the capacity requirements change to match the specific EVCI requirements of the jurisdiction. The wiring requirement ensures that the space can be upgraded to a load-managed Level 2 EVSE in the future.

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

Definition for fuel gas is mirrored from 2021 IMC to be useful in defining combustion equipment.

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

Definition for fuel oil is mirrored from 2021 IMC to be useful in defining combustion equipment.

MIXED-FUEL BUILDING. A *building* that contains *combustion equipment* or includes piping for *combustion equipment*.

SOLAR-READY ZONE. A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

Definition for solar-ready zone has been migrated from the 2021 IECC Appendix RB Solar-Ready Provisions to the base code.

Chapter 4 – Residential Energy Efficiency

R401 GENERAL

Revise text as follows:

R401.2.5 Additional energy efficiency. This section establishes additional requirements applicable to all compliance approaches to achieve additional energy efficiency.

1. For *all-electric buildings* complying with Section R401.2.1, one of the additional efficiency package options shall be installed according to Section R408.2.

2. For mixed-fuel buildings complying with Section R401.2.1, the building shall be required to install either R408.2.1 or R408.2.5 of the additional efficiency package options, and any two of R408.2.2, R408.2.3, or R408.2.4 of the additional efficiency package options. ~~For buildings complying with Section R401.2.2, the building shall meet one of the following:~~

~~2.1. One of the additional efficiency package Options in Section R408.2 shall installed without including such measures in the proposed design under Section R405; or~~

~~2.2. The proposed design of the building under Section R405.3 shall have an annual energy cost that is less than or equal to the 95 percent of the annual energy cost of the standard reference design.~~

3. For buildings complying with the Energy Rating Index alternative Section R401.2.3, the Energy Rating Index value shall be at least 5 percent less than the Energy Rating Index target specified in Table R406.5.

The options selected for compliance shall be identified in the certificate required by Section R401.3.

All-electric newly constructed homes typically use less energy when compared to newly constructed mixed-fuel homes. A recent Ecotope study[6] of the 2017 Oregon Residential code found that homes heated by electric heat pumps use 40 percent less energy than homes heated with gas (including water heating). This change seeks to encourage electrification and more evenly weigh the impact of the additional efficiency credits by requiring the mixed-fuel home to select a total of three packages from the options while the all-electric home is required to select one package. Of the three packages required for the mixed-fuel home, one must address the envelope (improved envelope or reduced infiltration plus better ventilation) while the remaining two impact HVAC (better equipment or more efficient ducts) and water-heating (better equipment) requirements.

Revise text as follows:

R401.3 Certificate. A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certification shall indicate the following:

4. The types, sizes, fuel sources, and efficiencies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall indicate "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be indicated for gas-fired unvented room heaters, electric furnaces and electric baseboard heaters.

8. The fuel sources for cooking and clothes drying equipment.

9. Where combustion equipment is installed, the certificate shall indicate information on the installation of additional electric infrastructure including which *equipment* and/or *appliances* include additional electric infrastructure, capacity reserved on the electrical service panel for replacement of each piece of combustion *equipment* and/or *appliance*

10. Where a *solar-ready zone* is provided, the certificate shall indicate the location, dimensions, and capacity reserved on the electrical service panel.

Revisions to this section incorporate critical elements of electrification and solar readiness to be clearly identified to the original homeowner/building owner and any subsequent owners to allow for easier mechanical swaps to electrical equipment and the installation of solar panels. By including on the certificate, the information is more likely to remain in the building for future owners.

[6] *Oregon Residential Specialty Code: 2005 Baseline and Code Roadmap to Achieve the 2030 Goal;* Ecotope (2020)

R402 BUILDING THERMAL ENVELOPE

Revise text as follows:

R402.1 General. The building thermal envelope shall comply with the requirements of Sections R402.1.1 through R402.1.5.

Exceptions:

1. The following low-energy buildings, or portions thereof, separated from the remainder of the building by *building thermal envelope assemblies* complying with this section shall be exempt from the building thermal envelope provisions of Section R402.
    1.1 Those containing no *combustion equipment* with a peak design rate of energy usage less than 3.4 Btu/h·ft2 (10.7 W/m2) or 1.0 watt/ft2 of floor area for space conditioning purposes.
    1.2 Those containing no *combustion equipment* that do not contain *conditioned space*.

Low energy buildings are currently exempt from thermal envelope requirements. This revision applies the same intention of low greenhouse gas impact that was given to low energy use impact when these building types were exempted.

R403 SYSTEMS

Revise text as follows:

R403.1.1 Thermostat ~~Programmable thermostat~~. The thermostat controlling the primary heating or cooling system of the dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature setpoints at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures of not less than 55°F (13°C) to not greater than 85°F (29°C). The thermostat shall be programmed initially by the manufacturer with a heating temperature setpoint of not greater than 70°F (21°C) and a cooling temperature setpoint of not less than 78°F (26°C). The thermostat shall be a d*emand responsive control* capable of increasing the cooling setpoint by no less than 4°F (2.2°C) and decreasing the heating setpoint by no less than 4°F (2.2°C) in response to a demand response request.

Demand responsive controls for thermostats are added based on language from California Title 24 and integrated into the current requirement for thermostats.

Add new text as follows:

R403.5.4 Demand responsive water heating. All electric water heating systems with a storage tank larger than 20 gallons (76 L) shall be provided with *demand responsive controls* that comply with ANSI/CTA-2045-B or another *approved demand responsive control*.

ANSI/CTA-2045-B standardizes the socket, and communications protocol, for heat pump water heaters so they can communicate with the grid, and with demand response signal providers. In addition, 2045-B adds control and communications requirements for mixing valves in HPWH to enable them to provide greater storage capacity to support increased load shifting. Versions of this standard are included in codes or other requirements in California, Oregon, and Washington.

R404 ELECTRICAL POWER AND LIGHTING SYSTEMS

Add new text as follows:

R404.4 Renewable energy infrastructure. The building shall comply with the requirements of R404.4.1 or R404.4.2

This code language has been migrated from the 2021 IECC Appendix RB Solar-Ready Provisions to the most appropriate place in the base code. By ensuring solar-ready zones, all-electric buildings will have the potential for an even greater impact on building decarbonization by contributing to the continued cleaning of the electricity supply.

R404.4.1 One- and two- family dwellings and townhouses. One- and two-family dwellings and townhouses shall comply with Sections R404.4.1.1 through R404.4.1.4.

Exceptions:

1. A *building* with a permanently installed on-site renewable energy system.

2. A *building* with a solar-ready zone area that is less than 600 square feet (55 m^2) of roof area oriented between 110 degrees and 270 degrees of true north.

3. A *building* with a solar-ready zone area that is shaded for more than 70 percent of daylight hours annually.

R404.4.1.1 Solar-ready zone area. The total solar-ready zone area shall be not less than 300 square feet (28 m^2) exclusive of mandatory access or set back areas as required by the International Fire Code. Townhouses three stories or less in height above grade plane and with a total floor area less than or equal to 2,000 square feet (186 m^2) per dwelling shall have a solar-ready zone area of not less than 150 square feet (14 m^2). The solar-ready zone shall be composed of areas not less than 5 feet (1524 mm) in width and not less than 80 square feet (7.4 m^2) exclusive of access or set back areas as required by the International Fire Code.

R404.4.1.2 Obstructions. Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

R404.4.1.3 Electrical service reserved space. The main electrical service panel shall have a reserved space to allow installation of a dual pole circuit breaker for future solar electric installation and shall be labeled “For Future Solar Electric.” The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location.

R404.4.1.4 Electrical interconnection. An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the *solar ready zone* by one of the following:

1. Minimum ¾-inch nonflexible conduit

2. Minimum #10 Metal copper 3-wire

Where the interconnection terminates in the attic, location shall be no less than 12" (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled "For Future Solar Electric".

As it is currently written, Appendix RB only requires that the construction documents indicate pathways for routing of conduit from the solar-ready zone to the service panel. This update requires the installation and verification of either conduit or wire from the roof or attic to the panel. This language has been adapted from the solar-ready language proposed for the residential Oregon Reach Code.

R404.4.1 Group R occupancies. Buildings in Group R-2, R-3 and R-4 shall comply with Section C405.13.

The 2021 IECC Appendix RB Solar-Ready Provisions address single and two-family dwellings only. Additional language is added to apply the approach for commercial buildings to multifamily residential construction.

Add new text as follows:

R404.5 Electric vehicle charging infrastructure. Electric infrastructure for the current and future charging of *electric vehicles* shall be installed in accordance with this section. *EV ready spaces* are permitted to be counted toward meeting minimum parking requirements.

R404.5.1 One- and two- family dwellings and townhouses. One- and two-family dwellings and townhouses with a dedicated attached or detached garage or on-site parking spaces and new detached garages shall be provided with one *EV-ready space* per *dwelling unit*. The branch circuit for the *EV ready space* shall have a minimum capacity of 9.6 kVA.

R404.5.2 Group R occupancies. Parking facilities serving Group R-2, R-3 and R-4 occupancies shall comply with Section C405.15.

Tailored requirements for single-family and multifamily housing have been included. Single-family homes, where the occupants will choose the specific EVSE that meets their EV charging needs, are required to have one parking space with an EV Ready space that is sized to accommodate the most common EVSE on the market. The requirements for EV charging infrastructure for multifamily buildings are referenced to the commercial requirements as those are more appropriate for EV charging in parking lots. The required capacity for the branch circuit for the EV Ready space is the equivalent of a 240V, 40A circuit and is expressed in kVA as that is the standard metric for capacity or "apparent power" in electrical infrastructure.

Add new text as follows:

R404.6 Additional electric infrastructure. *Combustion equipment* shall be installed in accordance with this section.

The following sections ensure that gas equipment can be more easily and cost-effectively retrofit with electric equipment in the future. This language is based on the approach adopted in the electrification reach codes adopted by various California cities. It combines the best elements from those reach codes and adapts them to the I-Code format.

R404.6.1 Equipment serving multiple units. *Combustion equipment* that serves multiple *dwelling units* shall comply with Section C405.13.

R404.6.2 Combustion water heating. Water heaters shall be installed in accordance with the following:

1. A dedicated 240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 3 feet (914 mm) from the water heater and be accessible to the water heater with no obstructions. Both ends of the branch circuit shall be labeled with the words "For Future Heat Pump Water Heater" and be electrically isolated.
2. A condensate drain that is no more than 2 inches (51 mm) higher than the base of the installed water heater and allows natural draining without pump assistance shall be installed within 3 feet (914 mm) of the water heater.
3. The water heater shall be installed in a space with minimum dimensions of 3 feet (914 mm) by 3 feet (914 mm) by 7 feet (2134 mm) high.
4. The water heater shall be installed in a space with a minimum volume of 700 cubic feet (20,000 L) or the equivalent of 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.

The addition of this section provides a series of requirements that ensure that the building can accommodate a HPWH in the future. Requirement 1 ensures that there is a branch circuit ready to support the future installation of a HPWH. Requirement 2 ensures that the condensate generated by a HPWH compressor can be easily drained away. Requirement 3 ensures that the water heater location is physically large enough to accommodate HPWHs that are frequently wider and/or taller than code-minimum gas water heaters. Requirement 4 ensures that a future HPWH has access to sufficient air volume to effectively operate.

R404.6.3 Combustion space heating. Where a building has combustion equipment for space heating, the building shall be provided with a designated exterior location(s) in accordance with the following:

1. Natural drainage for condensate from cooling equipment operation or a condensate drain located within 3 feet (914 mm), and
2. A dedicated branch circuit in compliance with IRC Section E3702.11 based on heat pump space heating equipment sized in accordance with R403.7 and terminating within 3 feet (914 mm) of the location with no obstructions. Both ends of the branch circuit shall be labeled “For Future Heat Pump Space Heater.”

Exception: Where an electrical circuit in compliance with IRC Section E3702.11 exists for space cooling equipment.

IRC Section E3702.11 sets the requirement for sizing a branch circuit serving a heat pump and relies on the size of the actual equipment to be installed. Since there is not an actual equipment size to reference and equipment size can vary depending on the size of the home and the climate, the section references Section R403.7 to establish the size of the heat pump equipment that would be required for the specific home.

> **R404.6.4 Combustion clothes drying.** A dedicated 240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 6 feet (1829 mm) of natural gas 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" and be electrically isolated.
>
> **R404.6.5 Combustion cooking.** A dedicated 240-Volt, 40A branch circuit shall terminate within 6 feet (1829 mm) of natural gas 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 Range" and be electrically isolated.

For jurisdictions concerned about impacts and stakeholder feedback on cooking appliances, language in R404.5 can be amended and combined with the requirements of an all-electric version of this code to allow for continued installation of combustion cooking, provided that the appliances be electric ready for future homeowner choice. IRC Section E3702.9.1 requires a 240V/40A branch circuit for a standard 8.75 kVA or larger electric residential range and has been used as the basis for the sizing of the branch circuit. Six feet is cited per requirements from IRC Section E3901.5 requiring appliance receptacles to be within 6 feet of the intended appliance.

> **R404.6.6 Other combustion equipment.** *Combustion equipment* and end-uses not covered by Sections R404.6.2-5 shall be provided with a branch circuit sized for an electric *appliance, equipment* or end use with an equivalent capacity that terminates within 6 feet (1829 mm) of the *appliance* or *equipment*.

SECTION 405 TOTAL BUILDING PERFORMANCE

Delete without substitution:

> ~~**R405 Total Building Performance**~~

Compliance with the performance path for consideration of greenhouse gas emissions and the needed increased stringency for mixed-fuel buildings requires manipulation of the standard reference design for space heating, water heating, and any other potential combustion end use. Given the limited application of Section R405 in new residential construction, for the purposes of this overlay, compliance via prescriptive path or ERI path create simpler enforcement options for jurisdictions.

SECTION 406 ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

Revise table as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION	TITLE
Mechanical	
R403.5 except Section R403.5.2	Service hot water systems
~~R403.5.1~~	~~Heated water circulation and temperature maintenance systems~~
~~R403.5.3~~	~~Drain water heat recovery units~~

The ERI mandatory requirements table has been modified to include the new requirement for demand responsive hot water control. Based on the structure of the table currently, combining R403.5 and creating a single in line exception is the most straightforward approach to this revision.

Revise table as follows:

TABLE R406.2 REQUIREMENTS FOR ENERGY RATING INDEX

SECTION [a]	TITLE
Electrical Power and Lighting Systems	
R404.1	Lighting equipment
R404.2	Interior lighting controls
R404.4	Renewable energy infrastructure
R404.5	Electric vehicle charging infrastructure
R404.6	Additional electric infrastructure
R406.3	Building thermal envelope

The ERI mandatory requirements table has been modified to include the new requirements for renewable energy, electric vehicle charging, and electric infrastructure as mandatory elements of the code amendments.

Revise text as follows:

R406.5 ERI-based compliance. Compliance based on an ERI analysis requires that the rated *proposed* design and confirmed built dwelling be shown to have an ERI less than or equal to the appropriate value for the proposed *mixed-fuel building* or the proposed *all-electric building* as indicated in Table R406.4 when compared to the *ERI reference design*.

TABLE R406.4 MAXIMUM ENERGY RATING INDEX

Climate Zone	~~Energy Rating Index~~ All-Electric Building	Mixed Fuel Building
0-1	52	43
2	52	45
3	51	47
4	54	47
5	55	47
6	54	46
7	53	46
8	53	45

This modification encourages homes following the ERI performance path to be all-electric by setting more stringent ERI values for mixed-fuel homes. This is needed as Standard 301, which sets the calculation methodology for calculating ERI, claims to be fuel agnostic. This means that there is no way to require that a home be all-electric without making significant modifications to Standard 301.

The ERI values for mixed-fuel homes match those from ASHRAE 90.2 and Appendix RC Zero Energy Residential Building Provisions as published in the 2021 IECC. The ERI values for all-electric homes are the same as the values published in Table R406.5 of the 2021 IECC.

R407 TROPICAL CLIMATE REGION COMPLIANCE PATH

Revise text as follows:

R407.2 Tropical climate region. Compliance with this section requires the following:

1. Not more than one-half of the *occupied* space is air conditioned and is controlled by a thermostat in accordance with Section R403.1.1.

3. Solar, wind or other renewable energy source supplies not less than 80 percent of the energy for service water heating controlled in accordance with Section R403.5.4.

12. Parking is in accordance with Section R404.6.

13. All *combustion equipment* is in accordance with Section R404.5.

Modifications to the Tropical Climate Region Path are minimal. This pathway in the 2021 IECC already does not allow any space heating and requires 80% of hot water be supplied by renewable energy. To ensure the inclusion of demand response controls, electric vehicles, and all other combustion equipment is addressed additional requirements are added to the tropical compliance list under R407.2.

R408 ADDITIONAL EFFICIENCY PACKAGE OPTIONS

Add new text as follows:

R408.2.3 Reduced energy use in service water-heating option. The hot water system shall meet one of the following efficiencies:

4. Greater than or equal to 82 EF instantaneous fossil fuel service water-heating system and drain water heat recovery unit meeting the requirements of Section R403.5.3 installed on at least one shower.

This new additional efficiency option provides builders with a fourth service hot water package that combines the efficiency benefits of an instantaneous gas water heater with a drain water heat recovery unit). Since mixed fuel buildings will be required to select more package options, the addition of this option provides additional flexibility for builders selecting to construct mixed fuel buildings, while continuing to encourage efficiency in combustion systems. This package reflects the requirements proposed in the Oregon Reach Code which was calibrated to other hot water package options based on analysis conducted by the Northwest Energy Efficiency Alliance[7] (NEEA).

Chapter 6 – Referenced Standards

Add new standard as follows:

CTA

Consumer Technology Association
1919 S. Eads Street
Arlington, VA 22202

Standard reference number	Title	Referenced in code section number
ANSI/CTA-2045-B	Modular Communications Interface for Energy Management	R403.5.4

[7] Heny Odum; Paul Kinter; *Oregon Residential Specialty Code: Energy Efficiency Analysis,* NEEA (March 2020)

Photo: Courtesy of the Northwest Energy Efficiency Alliance

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