**Revision of CEPI-203-21**

**Proponents:**

Helen Sanders, Façade Tectonics Institute/Technoform North America

**2021 International Energy Conservation Code:**

**Revise as follows:**

**C405.12 Energy monitoring**. New buildings with a gross conditioned floor area of 25,000 square feet (2322 m2) or larger shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.12.1 through C405.12.5. A plan for quantifying annual energy type and use disclosure in compliance with Sections C405.12.1 through C405.12.8 shall be submitted with the construction documents..

Exception: R-2 occupancies and individual tenant spaces are not required to comply with this section provided that the space has its own utility services and meters and has less than 5,000 square feet (464.5 m2) of conditioned floor area.

**C405.12.1 Electrical energy metering**. For all electrical energy supplied to the building and its associated site, including but not limited to site lighting, parking, recreational facilities and other areas that serve the building and its occupants, meters or other measurement devices shall be provided to collect energy consumption data for each end-use category required by Section C405.12.2.

**C405.12.2 End-use electric metering categories**. Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category indicated in Table C405.12.2. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the measured load for each of the end-use categories indicated in Table C405.12.2 shall be permitted to be from a load that is not within that category.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit shall not require end-use metering.

2. End-use metering shall not be required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.

3. End-use metering shall not be required for an individual tenant space having a floor area not greater than 2,500 square feet (232 m2) where a dedicated source meter complying with Section C405.12.3 is provided.

TABLE C405.12.2 ELECTRICAL ENERGY USE CATEGORIES

Table

Description automatically generated

Insert in table 405.12.2:

|  |  |
| --- | --- |
| Electric hot water heating | Electricity used to generate hot water. Exception: Electric water heating with design capacity that is less than 10% of building service rating |

**C405.12.3 Electric Meters.** Meters or other measurement devices required by this section shall be configured to automatically communicate energy consumption data to the data acquisition system required by Section C405.12.4. Source meters shall be allowed to be any digital-type meter. Lighting, HVAC or other building systems that can self-monitor their energy consumption shall be permitted instead of meters. Current sensors shall be permitted, provided that they have a tested accuracy of ±2 percent. Required metering systems and equipment shall have the capability to provide at least hourly data that is fully integrated into the data acquisition system and graphical energy report in accordance with Sections C405.12.4 and C405.12.5. Non-intrusive load monitoring (NILM) packages that extract energy consumption data from detailed electric waveform analysis can be substituted for individual meters if the equivalent data can be made available for collection in C405.12.4 and reporting in C405.12.5

**C405.12.4 Electrical energy ~~D~~data acquisition system**. A data acquisition system shall have the capability to store the data from the required meters and other sensing devices for a minimum of 36 months. The data acquisition system shall have the capability to store real-time energy consumption data and provide hourly, daily, monthly and yearly logged data for each end-use category required by Section C405.12.2. The data acquisition system shall have the capability of providing building total peak electric demand and the time(s) of day and time(s) of year at which the peak occurs. Peak demand shall be integrated over the same time period as the underlying meter reading rate, which is typically 15 minutes but shall be no longer than one hour.

**C405.12.5 Graphical energy report.** A permanent and readily accessible reporting mechanism shall be provided in the building that is accessible by building operation and management personnel. The reporting mechanism shall have the capability to graphically provide the electrical energy consumption for each end-use category required by Section C405.12.2 at least every hour, day, month and year for the previous 36 months. The graphical report shall also incorporate natural gas interval data or the ability to enter gas utility bills into the report.

**C40~~6~~5.12.6 Non-electrical energy:** Consumption of non-electrical energy such as gas, district heating or cooling, unregulated fuel sources, or other non-renewable energy shall be automatically metered or a method developed for usage calculation ~~at least~~ annually or more frequently from energy bills ~~developed~~. Natural gas usage shall be monitored ~~hourly~~ through on site interval metering or from utility interval data.

**C40~~6~~5.12.7 Renewable energy:** The ability to measure the production of on-site renewable energy shall be provided with ~~at least~~ the same or greater frequency as metered systems.

**C40~~6~~5.12.8 Plan for disclosure**: The plan for annual energy use data gathering and disclosure shall include the following

1. Property information including building type, total gross floor area, year built or year planned for construction completion, and occupancy type

2. Total annual building site energy use per unit area (square foot) of gross floor area as collected or documented through C40~~6~~5.12.5 (electrical) and C40~~6~~5.12.6 (non-electrical) sources, separated by energy type (electric, gas, district cooling or heating, unregulated fuel sources etc.). Electrical energy shall be further broken down by load type as identified in Table C405.12.2.

3. Annual site generated renewable energy per unit area (square foot) of gross floor area

4. Peak electric demand per unit area (square foot) of gross floor area, with an estimate of relative building system contribution to that peak, and the time and date of the peak.

5. For projects using the section C407 Total Building Performance approach to show compliance, include the following information from the building simulation:

5.1 Modeling software used

5.2 Assumptions made that impact the simulated annual energy use per unit (square foot or square meter) of gross floor area (e.g. occupancy schedules, daylighting assumptions, climate file, plug loads, envelope performance including use of shading systems).

5.3 Simulated annual energy use per unit (square foot or square meter) of gross floor area

5.4 Peak load, the time of date and time of peak and the hourly load profile on the day that experiences peak load.

Reason Statement:

Historically, energy efficiency has been a means to address concerns over oil and fuel shortages, using demand reduction to limit our “vulnerability to energy supply disruptions”[1]. Over the past five decades, however, the role of energy efficiency has morphed into something even more critical – playing a key part in slowing down the rate of anthropogenic climate change highlighted by the IPCC’s most recent Sixth Assessment Report and mitigating the impacts that climate change is already manifesting with dire consequences. As the International Code Council’s Energy Efficiency website itself states, “The International Code Council family of solutions is helping our communities forge a path forward on energy and sustainability to confront the impacts of a changing climate.”[2]

With buildings making up nearly 40% of the total greenhouse gas emissions globally [3], it is imperative that we start creating the ability to measure, monitor and disclose actual building energy use to inform actions to improve performance and feedback into the design process, rather than continue to rely on predicted energy consumption, which may not accurately reflect the building’s true energy consumption.

With building performance disclosure and reporting legislation for existing buildings becoming more widespread in the U.S., to address this issue of building energy use, it is important for the IECC, which covers the design and construction of new buildings, to prepare buildings and their owners for being able to easily comply with these requirements for energy monitoring and disclosure, and support the movement to a net zero carbon building future.

Of course, operational energy is not the only option we should pursue to mitigate the risks of climate change, but we should consider this a reasonable starting point, in line with the trajectory of the IECC. We need to close the information loop on building energy performance, and we need to do it fast. If we don’t provide the ability to, and start to track actual energy use now, and correlating that to design intent, how will we know what aspects of building design, operations, and maintenance require our focus and dedication to rectify or improve upon?

This proposal is for the 2024 code cycle, which means we only have two additional opportunities beyond this cycle to implement tangible step changes before we hit 2030, the target date for achieving zero energy buildings. Furthermore, in the context of the current COVID-19 pandemic, we are seeing significant shifts in the way buildings are being used, with more flexibility in office schedules, hotdesking or hoteling, variable occupancy levels, and the need for more (natural) ventilation. These shifts make it even harder for energy models to predict energy use in a meaningful and informative way using current best standards and methods.

Preparing buildings for ongoing post-occupancy measurement and verification is the only way to reliably track and manage energy use. Without data, we cannot glean information and turn that into knowledge and even wisdom of how our buildings operate. We are already seeing the following costs/risks associated with Business As Usual (BAU) here in the US and in Canada:- Shifting map of hurricane zones such that more areas are experiencing higher risks [4] (e.g., Hurricane Sandy affecting New England) - More extreme wildfires that create their own weather systems, making it even harder to contain them [5] (e.g., Bootleg Fire in Oregon) - Heat domes that exceed scientific predictions, even accounting for climate change [6] (e.g., Pacific NW in early 2021) Some are calling this the “social” cost of carbon, but it all boils down to a financial cost to humans – often inequitably – in the end. Fabia Jeddere-Fisher, Senior Lecturer in Energy Engineering of University of the West of England (UWE) Bristol, Department of Architecture & Built Environment who is in charge of “metering, monitoring, and reporting energy use” and “identifying and setting targets for energy/carbon savings across the UWE estate” noted that Display Energy Certificate ratings do in fact impact the way building users interact with the buildings.

**IECC Scope limitations - Plan for disclosure**

Since the scope of the IECC is only through design and construction and does not extend beyond the issue of the certificate of occupancy, we have modified our existing proposal to require design teams to create a plan for disclosure of key energy and carbon emission related data. This builds on an existing energy metering section, adding requirements for collecting non-electric energy usage, on-site renewable energy production, disclosing simulation data if projects follow the total performance path to allow for comparison, and a requirement to plan for estimating carbon emissions based on the sources of energy usage using best available data from utilities and other sources.

We originally suggested a 50,000 sq.ft. as the building size limit because of the relatively large impact that large buildings have on the overall energy usage, yet these comprise a relatively small number of actual buildings, but the current limit in this energy monitoring section is already 25,000 sqft, so we have not proposed making changes to the existing required size for simplicity in this section.

Note that the CBECS database indicates there are approximately 6 million commercial buildings with an average size of 16K sq.ft. Buildings of size greater than 50,000 sq.ft. represent a very small portion, ~5%, of the building stock in number, but around 50% of the floor area, and thus 50% of the energy impact. The 2018 Commercial Building Energy Consumption Survey [7] indicates that the top 3% of the largest buildings use 34% of the energy nationwide.

**Supporting disclosure ordinances and providing owners data**

We believe that addressing energy measurement and setting up a plan for disclosure for the big buildings first is much easier both logistically and administratively, while not giving up much impact or savings. The intent of this proposal is for preparing buildings to be able to comply with building disclosure and energy performance ordinances which is growing throughout the country and to remove barriers to disclosure [8,9]. It is intended to allow for future benchmarking of energy use, provide more transparency for building tenants, provide a needed feedback loop for energy simulation improvement, and to get the infrastructure in place for future measurement and verification opportunities, such as the possibility of spotting trends and providing insight into potential areas of improvement. By also including a requirement for the energy simulation data in the disclosure plan, this will also provide the necessary data for providing the feedback loop to improving simulation assumptions and accuracy which is important for closing the as-simulated to as-built performance gap.

**Energy to Carbon:**

With the focus on carbon and the decarbonization of electricity grids happening at different rates across the country, and the use of on-site renewable energy, simply measuring electrical energy usage is not sufficient as a proxy for carbon. Positioning the building’s owners and local jurisdictions to be able to translate electrical energy usage, minus on-site renewable electricity, and non-electrical fossil fuel usage into estimated carbon emissions is very important. Since procedures for translating energy usage to carbon emissions are not uniform and it may be more appropriate to leave this translation to local jurisdictions. As a result, this proposal requires the plan for disclosure to include non-electrical energy source usage and net electrical usage from the grid so that sufficient information is available to estimate the building’s carbon emissions.

**Bibliography:**

1. <https://www.ase.org/sites/ase.org/files/resources/Media%20browser/ee_commission_history_report_2-1-13.pdf>

2. <https://www.iccsafe.org/products-and-services/codes-standards/energy/>

3. <https://www.eia.gov/tools/faqs/faq.php?id=86&t=1>

4. <https://www.c2es.org/content/hurricanes-and-climate-change/>

5. <https://www.nytimes.com/2021/07/19/climate/bootleg-wildfire-weather.html>

6. <https://www.theguardian.com/environment/2021/jul/02/canadian-inferno-northern-heat-exceeds-worst-case-climate-models>

7. 2018 Commercial Building Energy Consumption Survey: <https://www.eia.gov/consumption/commercial/pdf/CBECS%202018%20Preliminary%20Results%20Flipbook.pdf>

8. https://www.osti.gov/servlets/purl/1168594 8https://database.aceee.org/state/building-energy-disclosure

9. <https://www.imt.org/public-policy/building-performance-policy-center/>

**Cost Impact:**

The code change proposal will neither increase nor decrease the cost of construction. Reporting data that is already available from utility bills, construction documents, and building simulations already submitted for code compliance and so will not change the cost of construction. If there is any administrative cost to disclosure, it should be minimal in the budget of a 25,000 sq.ft. building.

CEPI-203-21

**CEPI-22-21 Electric-Ready Mandate and All-Electric Appendix Proposal**

**Add new text as follows:**

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

**Revise text as follows:**

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

**Add new definitions as follows:**

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

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

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

**COMMERCIAL COOKING APPLIANCES.**Appliances 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.

**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.

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

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

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

**Revise text as follows:**

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

**Add new text as follows:**

**C405.16 Additional electric infrastructure.** Buildings that contain *combustion*

*equipment* and end-uses shall be required to install electric infrastructure in accordance with this section*.*

**C405.16.1 Combustion space heating.** Spaces containing *combustion equipment* for space heating shall comply with either C405.16.2.1 or C405.16.2.2

**C405.16.1.1 Low-capacity heating.** Spaces containing warm-air furnaces with a capacity less than 225,000 Btu/h and gas- and oil-fired boilers with a capacity less than 400,000 Btu/h shall be provided with a designated exterior location(s) that complies with the following:

1. Natural drainage for condensate from cooling equipment operation or a condensate drain located within 3 feet (914 mm) of the location of the space heating equipment, and
2. A dedicated branch circuit in compliance with NFPA70 Section 424.4 based on heat pump space heating equipment sized in accordance with the requirements of Section C403.1.1 and terminating within 3 feet (914 mm) of the location of the space heating equipment 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 NFPA70 Sections 440.4(B) and 440.35 exists for space cooling equipment.

**C405.16.1.2 High-capacity heating.** Spaces containing all other space heating *equipment* shall be provided with conduit that is continuous between a junction box located within 3 feet (914 mm) of the *equipment* and an electrical panel. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient capacity for an equivalent electric *equipment* with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, “For Future Electric Space Heating Equipment”.

**C405.16.2 Combustion water heating.** Spaces containing *combustion equipment* for water heating  shall comply with either C405.16.3.1 or C405.16.3.2

**C405.16.2.1 Low-capacity water heating.** Spaces containing water heaters with a capacity less than 300,000 Btu/h (88 kW) shall comply with the following:

1. A dedicated 208/240-volt branch circuit with a minimum capacity of 30 amps terminating within 3 feet (914 mm) from the water heater shall be provided 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,

1. The space shall meet minimum dimensions of 3 feet (914 mm) by 3 feet (914 mm) by 7 feet (2134 mm) high, and
2. The space shall meet 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.

**Exception:** Where items 1 and 2 are be provided at an exterior location capable of serving an outdoor compressor for a split-system heat pump water heater and a chase that is sized to accommodate refrigerant lines is provided between the outdoor location and the space required in item 3.

**C405.16.2.2 High-capacity water heating.** Spaces containing water heaters with a capacity greater than or equal to 300,000 Btu/h (88 kW) shall comply with the following:

1. Conduit that is continuous between a junction box located within 3 feet (914 mm) of the *equipment* and an electrical panel shall be provided. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient capacity for an equivalent electric *equipment* with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, “For Future Electric Water Heating Equipment”, and
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,

**C405.16.3 Combustion cooking**. Spaces containing combustion equipment for cooking shall comply with either C405.16.4.1 or C405.16.4.2

**C405.16.3.1 Commercial cooking.** Spaces containing *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.

**C405.16.3.2 Light and medium duty cooking.** Spaces containing light- and medium duty cooking *equipment* not designated as *commercial cooking appliances* shall be provided with a dedicated branch circuit in compliance with NFPA 70 Section 422.10. The branch circuit shall terminate within 6 feet (1829 mm) of fossil fuel ranges, cooktops and ovens and be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future Electric Cooking Equipment” and be electrically isolated.

**C405.16.4 Combustion clothes drying.** Spaces containing combustion equipment for clothes drying shall comply with either C405.16.5.1 or C405.16.5.2

**C405.16.4.1 Commercial drying.** Spaces containing clothes drying *equipment,* and end-uses for commercial laundry applications shall be provided with conduit that is continuous between a junction box located within 3 feet (914 mm) of the *equipment* and an electrical panel. The junction box, conduit and bus bar in the electrical panel shall be rated and sized to accommodate a branch circuit with sufficient capacity for an equivalent electric *equipment* with an equivalent equipment capacity. The electrical junction box and electrical panel shall have labels stating, “For Future Electric Clothes Drying Equipment”, and

**C405.16.4.2 Residential drying.** Spaces containing clothes drying *equipment, appliances,* and end-uses serving multiple *dwelling units*or sleeping areas with a capacity less than or equal to 9.2 cubic feet shall be provided with a dedicated 240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 6 feet (1829 mm) of fossil fuel clothes dryers and shall be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future Electric Clothes Drying Equipment” and be electrically isolated.

**Revise text as follows:**

**C406.1.1 Additional energy efficiency credit requirements for all-electric buildings.**

*All-electric* buildings shall comply with measures from C406.2 to achieve not less than the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone.

Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the conditioned floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

**Exceptions:**

1. Unconditioned parking garages that achieve 50% of the credits required for use groups S-1 and S-2 in Table C406.1.1.

2. Portions of buildings devoted to manufacturing or industrial use.

**Add text as follows:**

## C406.1.2 Additional energy efficiency credit requirements for mixed-fuel buildings.

## *Mixed-fuel buildings* shall comply with measures from C406.2 to achieve not less than the number of required efficiency credits from Table C406.1.2 based on building occupancy group and climate zone.

## Where a project contains multiple occupancies, credits in Table C406.1.2 from each building occupancy shall be weighted by the conditioned floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of Section C406.

## Exceptions:

## 1. Unconditioned parking garages that achieve 50% of the credits required for use groups S-1 and S-2 in Table C406.1.2.

## 2. Portions of buildings devoted to manufacturing or industrial use.

Table C406.1.2

Energy Credit Requirements by Building Occupancy Group for Mixed Fuel Buildings

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Building Occupancy Groups | Climate Zone | | | | | | | | | | | | | | | | | | |
| 0A | 0B | 1A | 1B | 2A | 2B | 3A | 3B | 3C | 4A | 4B | 4C | 5A | 5B | 5C | 6A | 6B | 7 | 8 |
| R-2, R-4, and I-1 | 134 | 130 | 141 | 147 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 144 | 150 | 150 | 150 | 150 | 150 | 150 |
| I-2 | 58 | 56 | 54 | 53 | 60 | 67 | 75 | 63 | 67 | 72 | 62 | 67 | 74 | 67 | 72 | 80 | 79 | 97 | 87 |
| R-1 | 79 | 75 | 82 | 78 | 81 | 91 | 92 | 93 | 98 | 102 | 96 | 102 | 117 | 104 | 110 | 128 | 118 | 135 | 132 |
| B | 85 | 82 | 84 | 86 | 81 | 80 | 87 | 83 | 85 | 94 | 88 | 92 | 101 | 93 | 93 | 114 | 106 | 114 | 105 |
| A-2 | 62 | 60 | 61 | 61 | 64 | 64 | 81 | 68 | 72 | 94 | 74 | 83 | 110 | 87 | 84 | 120 | 107 | 122 | 113 |
| M | 84 | 84 | 90 | 88 | 92 | 95 | 87 | 87 | 99 | 81 | 75 | 69 | 74 | 100 | 93 | 128 | 109 | 112 | 102 |
| E | 68 | 71 | 68 | 75 | 72 | 75 | 78 | 78 | 75 | 84 | 82 | 82 | 90 | 87 | 91 | 98 | 99 | 94 | 98 |
| S-1 and S-2 | 81 | 79 | 83 | 81 | 81 | 81 | 66 | 79 | 81 | 100 | 75 | 97 | 150 | 107 | 92 | 150 | 142 | 141 | 111 |
| All Other | 40 | 39 | 41 | 42 | 42 | 45 | 45 | 45 | 47 | 51 | 45 | 48 | 54 | 51 | 51 | 63 | 59 | 63 | 58 |

**Add new Appendix as follows:**

**APPENDIX CD ALL-ELECTRIC COMMERCIAL BUILDINGS**

**About this appendix:** *Appendix CD requires the installation of all-electric equipment and appliances in new construction in order to reduce carbon emissions and improve the safety and health of commercial buildings.*

**Section CD101**

**GENERAL**

**CD101.1 Intent.** The intent of this Appendix is to amend the *International Energy Conservation Code* to reduce greenhouse gas emissions and improve the safety and health of buildings by not permitting *combustion equipment* in buildings.

**CD101.2 Scope.** This appendix applies to new commercial buildings.

**Section CD102**

**ALL-ELECTRIC COMMERCIAL BUILDINGS**

**CD102.1 Application.** Commercial buildings shall be *all-electric buildings* and comply with Sections C401.2.1 or C401.2.2*.*

CEPI-217-21 Revision

*Add definition as follows:*

**EXTERIOR WALL ENVELOPE.** A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space, from the detrimental effects of the exterior environment.

**WORK AREA.** That portion or portions of a building consisting of all reconfigured spaces as indicated on the construction documents. Work area excludes other portions of the building where incidental work entailed by the intended work must be performed and portions of the building where work not initially intended by the owner is specifically required by this code.

*Modify the Section as follows:*

**C502.3 Compliance.** *Additions* shall comply with Sections C502.3.1 through ~~C502.3.6.2~~C502.3.7.

*Add sections as follows:*

**C502.3.7** **Additional energy efficiency credits.** *Additions* shall comply with measures from sections C406.2 and C406.3 to achieve not less than 50 percent the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section. *Alterations* to the existing building that are not part of an *addition*, but permitted with an *addition*, may be used to achieve the required credits.

**Exceptions:**

1. *Buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, High-Hazard Group H
2. *Additions* less than 1,000 ft2 and less than 50% of existing floor area.
3. *Additions* that do not include the addition or replacement of equipment covered by Tables C403.3.2(1) through C403.3.2(16) or C404.2.
4. *Additions* that do not contain *conditioned space*.
5. Where the *addition* alone or the existing building and *addition* together comply with Section C407

**C503.6 Additional energy efficiency credits.** *Alterations* shall comply with measures from sections C406.2 and C406.3 to achieve not less than 10 percent the number of required efficiency credits from Table C406.1.1 based on building occupancy group and climate zone. Where a project contains multiple occupancies, credits in Table C406.1.1 from each building occupancy shall be weighted by the gross floor area to determine the weighted average project energy credits required. Accessory occupancies shall be included with the primary occupancy group for purposes of this section.

**Exceptions:**

1. *Alterations to buildings* in Utility and Miscellaneous Group U, Storage Group S, Factory Group F, High-Hazard Group H
2. *Alterations* that do not contain conditioned space.
3. Portions of buildings devoted to manufacturing or industrial use.
4. Buildings in CZ 0A.
5. *Alterations* that include replacement of two or more of the following:
   1. HVAC unitary systems or HVAC central heating or cooling equipment serving the *work area* of the *alteration*.
   2. Water heating equipment serving the *work area* of the *alteration.*
   3. 50% or more of the lighting fixtures in the *work area* of the *alteration*.
   4. 50% or more of the area of interior surfaces of the *thermal envelope* in the *work area* of the *alteration.*
   5. 50% or more of the area of the *building’s* *exterior wall envelope*
6. *Alterations* that are permitted with an *addition* complying with section C502.3.7.
7. *Alterations* that comply with Section C407.

## Reason for Revision

The revised proposal provides clarifications to the approach in the original proposal and aligns the proposal with action taken by the committee in approving CEPI-193.

**Additions**

* The proposal sets the credit target for additions in a way that is compatible with CEPI-193. It is effectively a version of C406.1.1 for additions. It requires that an addition achieve half the credits required by Section C406.2, but it does not require any of the credits required by C406.3. However, it does allow the addition to count credits from C406.3 to meet that requirement. The intent is to maximize the flexibility of C406 for application to additions.
* It includes exemptions for structures and spaces exempted from C406 and for multiple types of additions that would likely struggle to achieve even half the credits of a whole new building, including those that do not include space conditioning or water heating equipment, small additions and unconditioned additions.
* It allows an alteration and an addition to comply together when they are on the same permit in order to simplify design and compliance for those projects.

**Alterations**

The modifications to the alterations section do several things:

***Threshold:***

It provides a clearer threshold to ensure that the requirements only apply to substantial alterations. The proposal introduces the definition of “work area” from the IEBC in order to clearly delineate the portion of the building that is part of the alteration. Only alterations that include replacement of more than 50% of two or more of the major energy systems of the building – envelope, HVAC, water heating, lighting - would be subject to the requirement. Each of these items are themselves substantial alterations of the major energy systems in a building. 50% was chosen because it is a common threshold used for requirements in the IEBC, such as the area threshold for Level 3 alterations. It leverages the definition for “exterior wall envelope” from the IBC for alterations to the exterior of the thermal envelope to provide a consistent way to talk about building re-skinning activities.

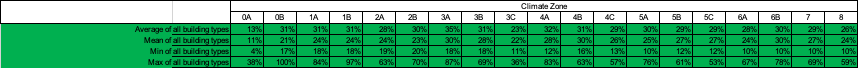
This approach was chosen over the Level 1-3 approach in the IEBC because those thresholds are not well-tuned to the energy systems. Those thresholds are concerned primarily with egress and accessibility, so they are framed in terms of reconfiguration of spaces, particularly the moving of doors or windows. A building could be completely gutted, completely reskinned, with all lighting, space conditioning and water heating equipment replaced and still only be considered a Level 1 alteration as long as no door or windows were moved/added and the equipment replacements did not include additional equipment. Conversely, an alteration might be considered Level 3 because it includes substantial alterations to egress paths but include only minimal impacts to energy systems. This sets a threshold appropriate to the IECC.

***Credit Target:***

The proposal sets a target for covered alterations of just 10% of the efficiency credits of C406. 10% was chosen based on an assessment of the available credits to create a reasonable target for the worst-case alteration subject to this requirement. The worst-case was defined as a project with alterations to the two energy systems with the lowest average credit value available. We calculated the average credit value for each building energy system subject to the alteration threshold: envelope, space conditioning, water heating, lighting. We then added the total of the two categories with the lowest average credit value to represent the worst-case scenario.

When compared to the credits required by Table C406.1.1 in terms of percentage, the total value of the two worst category averages was 10% or more for all building types and all climate zones except 0A (which is why the proposal includes an exception for that climate zone).

Figure 1: Summary of the credits available to the “worst-case” alteration.



This is a conservative target threshold. A project would never have to achieve more credits than the average credit value of each energy system category impacted by the alteration. This ensures that there is still flexibility and that a project would never have to utilize all of the credits available to their alteration.,

***Other Exceptions:***

The proposal brings over exemptions from CEPI-193 such as garages and manufacturing areas. It also exempts alterations that are part of an addition that complies with the additional efficiency requirements for additions in order to simplify compliance for those projects. And it excludes projects that comply with C407.

**CEPI-255 – modified Above Base Energy Code Provisions**

~~X101.1 Scope.~~

~~The provisions of this appendix shall apply to new construction.~~

X101.1 New construction shall comply with the requirements of ~~the~~ this code and one of the following:

1. This appendix,
2. The International Green Construction Code,
3. The National Green Building Standard, at a silver, gold, or emerald level of certification

~~for new construction and shall comply with the provisions of this appendix. Alternatively, new Construction shall comply with this appendix, the~~ *~~International Green Construction Code,~~* ~~or the ICC-700~~ *~~National Green Building Standard~~* ~~at a silver, gold, or emerald certification.~~

~~Exception: Projects that comply with the International Green Construction Code or obtain a silver certification from the National Green Building Standard shall be deemed to comply with the provisions of this appendix.~~

X102.1 Air ~~barriers~~ leakage.

~~Air barrieriWhere an air barrier is not required by section C402.5.1, a~~ A continuous *air barrier* shall be provided throughout the *building thermal envelope*. The continuous air barriers shall be located on the inside or outside of the *building thermal envelope*, located within the assemblies composing the *building thermal envelope*, or any combination thereof. The air barrier shall comply with Sections C402.5.1.1, and~~/or~~ C402.5.1.2.

X102.1.1 Air barrier verification.

All air barriers components and systems shall be verified in accordance with Section ~~C402.5.1.5~~C402.5.2.

~~X102.1.1.1 Testing~~

~~The building, dwelling, or sleeping unit shall be tested for air leakage in accordance with Sections C402.5.2 or C402.5.3.~~ Where required by the code official, testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the party conducting the test and provided to the code official.

~~1. Buildings or portions of buildings, including Group R and I occupancies, shall meet the provisions of Section C402.5.2.~~

~~2. Buildings or portions of buildings other than Group R and I occupancies shall meet the provisions of Section C402.5.3.~~

~~X103.1 Heating outside uses.~~

~~Mechanical systems providing a heat source outside of the thermal envelope of a building shall comply with Sections X103.1.1 through X103.1.3~~

X103.1~~.1~~ Snow and ice melt systems.

~~Snow and ice melt systems shall install a minimum R-10 insulation located below the tubing and or piping utilized in the heating system for snow and ice melt systems.~~

~~Exception: snow and ice melt systems located on roof when the location of the thermal envelope is not located at the roof, but at the ceiling.~~

Snow and ice melt systems shall ~~install~~ have insulation of not less than ~~a minimum~~ R-10 ~~insulation~~ located below ~~tubing and or~~ thermal elements or piping utilized in the heating system. ~~for snow and ice melt systems.~~

**Exception:** Snow and ice melt systems located on roofs ~~when the location of~~ outside of the thermal envelope. ~~is not located at the roof , but at the ceiling.~~

~~X103.1.2 Swimming pools and spas.~~

~~Permanent swimming pools and spas shall have insulation on the sides and bottom surfaces located on the exterior. The type of insulation shall be impermeable and impervious to water logging or saturation and unaffected by water, mold, mildew, and have capability to resist compression. The insulation value shall be a minimum of R-15.~~

~~X103.1.3 Automatic Covers.~~

~~Permanent swimming pools and spas shall have insulation on the sides and bottom surfaces located on the exterior. The type of insulation shall be impermeable and impervious to water logging or saturation and unaffected by water, mold, mildew, and have capability to resist compression. The insulation value shall be a minimum of R-15.~~

~~Automatic covers. Swimming pools and spas located inground shall have an automatic motorized non-permeable pool cover that covers the entire pool surface.~~

X104.1 Appliances.

The following appliances shall meet ENERGY STAR performance criteria or equivalent.

1. Water coolers

2. Commercial Fryer

3. Commercial hot food holding cabinets

4. Commercial steam cookers

5. Commercial dishwashers

6. Commercial Griddles

7. Commercial ovens

8. Commercial refrigerator and/or freezers

X105.1 Additional efficiency package options.

Projects complying with this appendix shall be required to achieve an additional 5 credits ~~for a total of 15~~ ~~points~~ from Tables C406.1(1) through C406.1(5).

Add new standard(s) as follows:

ICC

International Code Council, Inc.

500 New Jersey Avenue NW 6th Floor

Washington, DC 20001

IgCC - ~~2024~~ 2021 International Green Construction Code

700-2020 National Green Building Standard

**The Glide Path Appendix 5/13/22 Revision**

**X.1 Prescriptive compliance.** Where compliance is demonstrated using the prescriptive compliance option in Section C401.2.1, the additional efficiency credits required by Section C406.1 shall be **XX (15% higher than that required by Table C406.1.1?).** [*NOTE: This number of credits to be finalized when the energy use reduction of the 2024 IECC base code can be estimated, so that it results in a net 10% energy cost reduction compared with the 2021 IECC.]*

**X.2 Total Building Performance compliance.** Where compliance is demonstrated using the total building performance option in Section C401.2.1, the *proposed design* energy cost shall be be **XX (76?)** percent rather than **85** percent of the *standard reference design* energy cost. *[NOTE: This percentage to be finalized when the energy use reduction of the 2024 IECC base code can be estimated, so that it results in roughly a net 10% energy cost reduction compared with the 2021 IECC.]*

**X.3 On-site renewable electricity systems.** Buildings shall install equipment for on-site renewable electricity generation with a direct current (DC) nameplate capacity rating of not less than that computed using Equation X-2:

A + B/3 = C                         Equation X-1

Where:

A = conditioned area in ft2

B = Semi-heated and nonconditioned area in ft2

C = Adjusted area

C x D = REQ                        Equation X-2

Where:

C = Adjusted area

D = Value from Table X-3 in watts

REQ = Required capacity in watts

**Exceptions.** 1. Any required renewable electricity generation capacity in excess of 10 W/ft2 (108 W/m2) of net available roof area is permitted to be provided using an off-site renewable energy system in accordance with Section X.4. For the purposes of this section, net available roof area is the gross roof area minus the roof area occupied by any combination of skylights, mechanical equipment, vegetated space, required access pathways, vehicle parking, and occupied roof terrace area.

2. The following buildings are permitted to provide off-site renewable energy generation in accordance with Section X.4 in lieu of all or part of the on-site renewable energy generation capacity required by Section X.3.

a. Any building where more than 50% of roof area would be shaded from direct-beam sunlight by existing natural objects or by structures that are not part of the building for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.

b. A building with gross conditioned floor area less than 1,000 square feet (93 m2).

c. A building whose primary roof slope is greater than 2 in 12.

3. Alternate forms of on-site *renewable energy generation capacity* are permitted where the annual energy generation is calculated using an *approved* methodology to be no less than that produced by the required solar capacity.

4. All or part of the required *renewable energy generation capacity* is permitted to be replaced by other efficiency measures projected to reduce the annual energy consumption of the building by an amount no less than that which would otherwise be produced annually by the required renewable energy capacity, as calculated using the total building performance compliance path in Section C407 and *approved* methodologies for solar production.

**Table X.3 On-site renewable electricity**

|  |  |
| --- | --- |
| Climate Zone | Capacity |
| 1A, 2B, 3B, 3C, 4B, and 5B | 2.0 W/ft2 (22 W/m2) |
| 0A, 0B, 1B, 2A, 3A, and 6B | 2.3 W/ft2 (25 W/m2) |
| 4A, 4C, 5A, 5C, 6A, and 7 | 2.6 W/ft2 (29 W/m2) |

**X.4 Off-site renewable energy.** Buildings that qualify for one or more of the exceptions to Section X.3 and do not fully comply with Section X.3 with the on-site renewable energy system, shall procure off-site renewable electrical energy, in accordance with Sections X.4.1, X.4.2 and X.4.3, that shall not be less than the total off-site renewable electrical energy determined in accordance with Equation X-4.

PROV/REQ = E                  Equation X-3

Where:

REQ = Required capacity in watts

PROV = Provided capacity in watts

E = Proportion of capacity provided

C x (1-E) x 4.4 = OFF         Equation X-4

Where:

C = Adjusted area in ft2

E = Proportion of capacity provided

OFF = kWh/year to be contracted off-site

**X.4.1 Off site procurement.** The building owner as defined in the International Building Code shall procure and be credited for the total amount of off-site renewable electrical energy, not less than required in accordance with Equation X-1, with one of the following:

1. Community *renewables energy facility*

2. *Financial renewable energy power purchase agreement*

3. *Physical renewable energy power purchase agreement*

4. *Direct ownership*

5. *Renewable Energy Investment Fund*

**X.4.2 Off-site contract.** The renewable energy shall be delivered or credited to the building site under an energy contract with a duration of not less than 10 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property. The total required off-site renewable electrical energy shall be procured in equal installments over the duration of the off-site contract.

**X.4.3 Renewable energy certificate (REC) documentation.** The property owner or owner's authorized agent shall demonstrate that where RECs are associated with on-site and off-site renewable energy production required by Sections X.3 and X.4, all of the following criteria for RECs shall be met:

1. They are retained and retired by or on behalf of the property owner or tenant for a period of not less than 10 years or the duration of the contract in X.4.2 whichever is less;

2. They are created within a 12-month period of the use of the REC; and

3. They represent a generating asset constructed no more than 5 years before the issuance of the certificate of occupancy.

Add new definition to Section C202:

**RENEWABLE ENERGY INVESTMENT FUND (REIF).** A fund established by the local government or other entity to accept payment from building owners to construct or acquire qualifying renewable energy (along with RECs) on their behalf.

**Reason Statement**

This appendix is intended to be adopted by jurisdictions that will require new construction to operate at net zero energy by the year 2030. It reduces the net annual energy use of buildings by approximately one-third in comparison with buildings constructed in compliance with the 2021 IECC, assuming that the 2027 and 2030 editions will also reduce energy use by one-third each.

It is estimated that *regulated* energy uses in buildings can be cut by 50% from current levels by 2030, but that unregulated loads and large community process loads will only diminish about 15% in the same time period. If regulated loads comprise 60% of building energy use, and unregulated loads (not counting large process loads) comprise the remaining 40%, halving the regulated loads would result in a 30% reduction in energy use, or 10% for each of the three Glide Path steps. Reducing unregulated and process loads by 15% over this decade would result in an additional 9% overall building energy use reduction by 2030, or 3% reduction per code cycle. Some of this 13% reduction (10% regulated and 3% unregulated/process) will occur in the base code development, and the remainder is required by this appendix.

For the 2030 ZNE target, renewable or site-recovered energy will be required to compensate for the remaining half of regulated energy use, plus the typical unregulated building energy use, and an additional amount to cover a proportionate share of community process energy.

Rather than burdening those buildings that contain large process loads (restaurant, grocery, hospital, data center, laboratory, etc.) with a requirement to provide renewable energy to cover their entire operating energy use, this Appendix requires an additional amount of renewable energy for *all* new building square footage in recognition of the fact that those large process loads serve the entire community with essential services. It is estimated that such community process loads equal approximately 20% of all other building energy loads.

If 39% of a building’s net energy use reduction can be covered with efficiency and technology improvements, the remaining 61% of the *net* energy use reduction will be accomplished with acquisition of renewable energy resources, also in three roughly equal steps. Assuming typical PV production to be 1.5 kWh/year/watt, this would result in a requirement for 7 W/sf of conditioned floor area for 2030, or roughly 2.4 W/sf for 2024. For semi-heated or unconditioned space, the requirement will be 1/3 of this amount, or 0.8 W/sf for 2024.

For this revised proposal, three solar regions of six climate zones each have been established, with on-site renewable energy capacity requirements of 2.0, 2.3 and 2.6 watts per square foot. The basis for this updated provision is a 2030 renewable energy production target of 10.5 kWh/sf/year for all buildings based on the same assumptions above; the corresponding 2024 target is 3.5 kWh/sf/year. PV production assumptions are based on another proposal adopted by the Committee: 1.35 kWh/kW/year (lower latitudes), 1.55 kWh/kW/year (mid-latitudes) and 1.75 kWh/kW/year (upper latitudes). The off-site renewable energy allowance provision of 4.4 kWh/sf/yr includes an 80% derating to account for the risk associated with such procurements compared to renewable energy installed on-site.