FSEC Energy Research Center

UNIVERSITY OF CENTRAL FLORIDA

# Comparison of the 2023 Commercial Florida Building Code, Energy Conservation, 8th Edition with 2024 IECC

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## Acronyms and Abbreviations

| | |
|---|---|
| DOE | U.S. Department of Energy |
| ECI | Annual Energy Cost Index, $/(ft$^2$-yr) |
| EUI | Annual Energy Utilization Intensity, kBtu/(ft$^2$-yr) |
| FBC-EC | Florida Building Code, Energy Conservation |
| FBCEC-2023 | 2023 Florida Building Code, Energy Conservation |
| FSEC | Florida Solar Energy Center |
| HVAC | Heating, ventilation, and air-conditioning |
| IES | Illuminating Engineering Society of North America |
| IECC | International Energy Conservation Code |
| PAEC | Percentage of the Annual Energy Cost of the Standard Reference Design |
| PNNL | Pacific Northwest National Laboratory |

**Simulation Prototype Terminology**

| | |
|---|---|
| **IECC-Based 2023 FBCEC** | is a building energy model designed to simulate the 8$^{th}$ Edition (2023) FBC-EC, which is IECC-based. |
| **IECC-2024** | is a building energy model that simulates the 2024 IECC. |

## Executive Summary

The State of Florida desired to conduct a qualitative and quantitative comparative analysis of commercial provisions of the 8th Edition (2023) Florida Building Code, Energy Conservation (FBC-EC) against the 2024 IECC. The primary tasks included in this final report are:

- Review and compare the 2023 FBC-EC against the draft 2024 IECC
- Identify and list code changes with an energy impact
- Analyze the IECC-based 2023 FBC-EC and the 2024 IECC and determine the simulated energy use performances of the codes
- Provide qualitative and quantitative cost-effectiveness analysis of the code changes

Two reviews were conducted: (1) the code change between the 2021 IECC code with the 2024 IECC and (2) the IECC-based 2023 FBC-EC with the draft 2024 IECC. The review identified the impacts of the changes in energy and construction costs. Appendix A provides a detailed listing of the code changes with energy impact and a brief description of each, offering an understanding of the code changes. A total of 238 code changes were introduced into the draft 2024 IECC, with ninety-four having direct and indirect energy impacts. Mechanical systems, lighting systems, and additional energy efficiency measures changes account for 89% of the energy impact, highlighting the areas of significant change. The qualitative comparison of the code changes was completed and presented to the Florida Building Commission in June 2024.

This report is focused on the comparative energy use performance analysis of the IECC-based 2023 FBC-EC and the 2024 IECC Code. A simulation based analysis was conducted by creating model energy code that covers the prescriptive, mandatory, and additional efficiency measure requirements. The additional energy efficiency measures were accounted for using two approaches: (1) modeling the selected additional energy measures in the prototype models; and (2) using the Percentage Annual Energy Cost (PAEC) adjustment. The analysis modified the 2021 IECC DOE/PNNL IECC commercial prototype building energy models to create the IECC-Based 2023 FBC-EC and the 2024 IECC equivalent commercial prototype buildings model energy code. Sixteen commercial prototype building energy models were created for each climate zone and code base. EnergyPlus, a whole-building energy simulation program, was used to analyze those energy-impactful changes quantitatively.

Three levels of comparative quantitative analysis were conducted: (1) analysis without the additional energy efficiency measures, (2) with the additional efficiency measures, and (3) without the additional efficiency measures and PAEC adjustment. The PAEC adjustment was applied to the Energy Cost Index (ECI) as well as the Energy Utilization Intensity (EUI). The PAEC value is a fixed 85% for the 2023 FBC-EC; the IECC 2024 varies from 75% to 81% by building occupancy group and climate zones.

Figure I shows the state's annual site Energy Utilization Intensity (EUI) of the IECC-based 2023 FBC-EC and the 2024 IECC by prototype building types for the three scenarios. Figure II shows the Energy Cost Index (ECI). The annual site EUI aggregated across the sixteen prototype buildings for the IECC-Based 2023 FBC-EC was higher than that of the 2024 IECC by 3.49% to 12.86%, depending on the analysis scenarios. At the same time, the ECI is higher by 10.52% to 19.25%. The IECC-based 2023 FBC-EC average energy use was higher due to three main

reasons: (1) the exclusion of a selected Section of the 2021 IECC requirements such as automatic receptacle control, fenestration and skylight upgrade, secondary sidelight area from the 2023 FBEC-EC, (2) energy-impactful new code modifications including expanded additional energy efficiency measures added to the 2024 IECC, and (3) on-site renewable energy generation prescriptive requirements addition to the 2024 IECC. The 2024 IECC's higher percentage of ECI savings than the EUI savings is mainly due to net metering of the on-site generated renewable energy. It is crucial to note that this analysis indicates the need to update the IECC-based 2023 FBC-EC by adding energy-impactful changes from the 2024 IECC. It is also strongly recommended that some of the code changes excluded from the 2023 FBC-EC be considered.

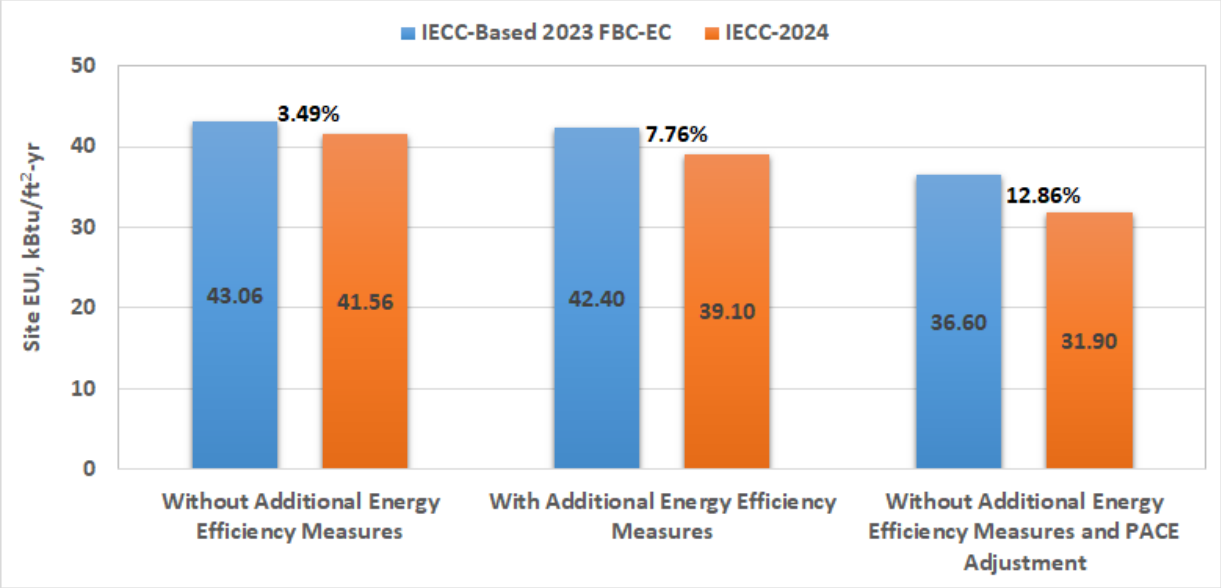


Figure-I Florida Average Site EUI and Percent Difference of the IECC-Based 2023 FBC-EC and the 2024 IECC

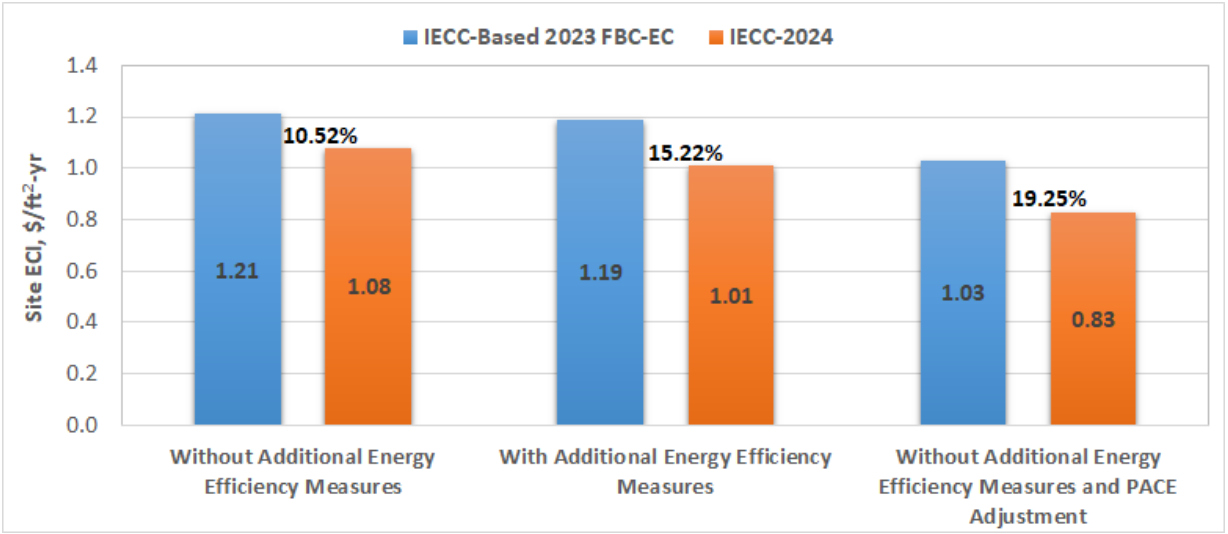


Figure-II Florida Average Site ECI and Percent Difference of the IECC-Based 2023 FBC-EC and the 2024 IECC

A qualitative cost-benefit analysis was conducted for code changes with significant energy impacts, and a quantitative cost-benefit analysis was conducted for selected code modifications with quantifiable energy impacts, which can be modeled in EnergyPlus. The additional efficiency measures are not included in the quantitative cost-benefit analysis.

# 1. Introduction

The State of Florida, in its pursuit of a comprehensive understanding of the commercial provisions of the 8th Edition (2023) Florida Building Code, Energy Conservation (FBC-EC), has commissioned a qualitative and quantitative comparative analysis. This report, of significant importance to State officials, building code professionals, and energy conservation experts, presents a summary of the quantitative analysis of the code changes between the 2023 FBC-EC and the 2024 IECC. The 2023 FBC-EC is Florida's Building Energy Code based on the 2021 IECC with additional changes. The 2024-IECC is the first print ( IECC, 2024). The report identifies code changes with energy impact for the 2024 IECC changes and conducted comparative energy use performance of the IECC-based 2023 FBC-EC and the 2024 IECC model energy codes determined using EnergyPlus, a whole building performance simulation program. Furthermore, the report entails qualitative cost-benefit and a limited quantitative cost-benefit analysis of the code changes with significant energy impacts.

### Code Changes Qualitative Analysis:

- Reviewed and compared the code changes between the IECC-based 2023 FBCEC and the 2024 IECC
- Provide code change listing and identify changes with energy impact.
- Provided qualitative cost-effectiveness for code changes with energy impacts

Our review and comparison of the IECC-Based 8th Edition (2023) FBC-EC and the draft 2024 IECC energy code is despite the official 2024 IECC not being published at the time of writing this report. We identified code medications with significant energy impact. We have also highlighted the impacts of these changes on the construction cost, where possible, providing a practical understanding of the report's findings. Appendix A provides a brief description of each of the changes incorporated into the 2024 IECC and a brief description of the anticipated changes relative to the 2023 FBC-EC. The comprehensive qualitative analysis was completed and presented to the Florida Building Commission in June 2024. This report focuses on the quantitative analysis of the code changes with significant energy impacts, a qualitative cost-benefit analysis, and a quantitative cost-effectiveness analysis of selected code changes.

### Code Change Quantitative Analysis:

FSEC conducted a comparative building energy performance analysis of the IECC-Based 2023 FBC-EC and the 2024 IECC for climate zones 1A and 2A. Model energy code were created for each code base representing the prescriptive requirements, mandatory requirements, and additional efficiency measure requirements. Each code base and climate zone is represented using sixteen commercial prototype building energy models. These prototype building energy code models were created by modifying the DOE/PNNL prototype building model energy codes. The IECC-Based 2023 FBC-EC and the 2024 IECC prototype building model energy codes were created by modifying the 2021 IECC DOE/PNNL prototype building models. The model energy code analysis covers the prescriptive requirements, mandatory requirements, and additional efficiency measure requirements. The HVAC equipment minimum efficiency values in the 2023 FBC-EC and the 2024 IECC model energy codes were set to the same values as the 2024 IECC. This assumption is based on the fact that model energy codes must be compared with the exact federal minimum efficiency requirements. A three scenarios comparative energy use and energy

cost analysis results between the IECC-based 2023 FBC-EC and the 2024 IECC were summarized in Section 5: (1) quantitative analysis without additional efficiency measures, (2) quantitative analysis with additional efficiency measures, and (3) quantitative analysis without additional efficiency measures and the Percentage Annual Energy Cost (PAEC) adjustment. PAEC is the percentage of the annual energy cost of the standard reference design. The PAEC is a fixed 85% for the 2023 FBC-EC; for the IECC 2024, it varies from 75% to 81%, depending on the building occupancy group and climate zones. PAEC adjustment use is described in Section 5.6. Appendix B summarizes details of the additional energy efficiency measures modeling assumptions by building occupancy groups and climate zones. The report presents the EUI and ECI values for the three quantitative analysis scenarios. The three scenarios give insight into the impacts of the additional efficiency measures and the PAEC adjustment on the code change performance.

### Code Change Cost-Benefit Analysis:

Qualitative and quantitative cost-benefit analysis of the code changes added to the 2024 IECC was conducted for energy-impactful code modifications. The quantitative cost-effectiveness analysis was conducted on six new code changes only. The quantitative cost-benefit analysis did not cover the changes in additional energy efficiency measures. However, a qualitative cost-benefit analysis was conducted on all code changes with significant energy impact. The quantitative cost-effectiveness findings are summarized in Section 6, and the analysis details are in Appendix E. Appendix A contains the qualitative cost-benefit analysis summary for significant energy impact code changes.

## 2. The 2023 FBC-EC Qualitative Comparison with 2024 IECC

The 8th Edition (2023) Florida Building Code, Energy Conservation (FBCEC) was compared with the draft 2024 IECC document provided by the Florida Department of Professional Regulation (DBPR). Appendix-A summarizes the changes between the 2021 IECC and the 2024 IECC and between the IECC-based 2023 FBC-EC and the 2024 IECC. It also indicates the impact of energy and construction costs if FBC were to adopt the changes. The code change review covers the 238 code modifications in the draft 2024 IECC document. The review identified 94 code modifications with direct and indirect energy impacts, and 29 of the changes were additional energy efficiency measures. Table 1 summarizes the code change distribution by code sections.

Table 1 Distribution of Code Modifications Count in the 2024 IECC

| Commercial Code Section | Code Changes, Count | Code Changes with Energy Impact, Count |
|---|---|---|
| Chapter C4: Commercial Energy Efficiency | 198 | 81 |
| Chapter C5: Existing Buildings | 27 | 13 |
| Total | 238 | 94 |

### 2.1 The 2024 IECC Impactful Code Changes

The review identified ninety-four code changes with direct and indirect energy impacts, thirty-nine of which were additional efficiency measures. However, the prototype building models included only 20 code modifications in the quantitative energy performance analysis.

Table 2 Impactful Code Modifications Count in the 2024 IECC

| Commercial Code Section | Impactful Changes | Included in the Analysis |
|---|---|---|
| C402: Envelope | 5 | 1 |
| C403: Building Mechanical System | 14 | 4 |
| C404: Service Water Heating | 1 | |
| C405: Electrical Power and Lighting System | 19 | 4 |
| C406: Additional Efficiency Measures | 39 | 11 |
| C407: Simulated Building Performance | 1 | |
| C5: Existing Buildings | 13 | |
| Total | 94 | 20 |

## 3. Florida Climate Zones

Based on DOE's climate zone classification, Florida has two climate zones: very hot and humid (1A) and hot and humid (2A). Representative site locations for climate zones 1A and 2A selected for the quantitative analysis were Miami, Florida (1A, very hot, humid) and Tampa, Florida (2A, hot, humid). Tampa was selected as a representative site location for Climate Zone 2A mainly because it is the geographic center for large cities in the Climate Zone 2A region of the State. Miami, the largest city in Climate Zone 1A, was selected as a representative site location. The Florida commercial building stock floor area distribution by climate zones and building types and the data used to drive them are provided in Appendix D.

## 4. Quantitative Analysis of the IECC-Based 2023 FBC-EC

The quantitative analysis determined and compared annual total Energy Utilization Intensity (EUI) and annual Energy Cost Index (ECI) by prototype building type and floor area weighted Florida average. Sixteen commercial prototype building types represented the Florida commercial new construction building's total floor area stock. The floor area weighing factors by building type used for the analysis are summarized in Table 3. The annual energy use and cost comparison of the prototype buildings' energy model designed with the IECC-Based 2023 FBC-EC against the 2024 IECC were determined. The comparative energy performance analysis between the IECC-based 2023 FBCEC and the 2024 IECC has not been conducted due to delays in the latter's publication.

The 2024 IECC prototype building model energy code was created by modifying the DOE/PNNL reference prototype building energy models published by the Pacific Northwest National Laboratory (PNNL) (DOE, 2023). The IECC-based 2023 FBC-EC prototype building model energy codes were developed by modifying the 2021 IECC commercial prototype building models. The sixteen prototype commercial building energy models of the 2023 FBC-EC and the 2024 IECC code were simulated for Miami and Tampa site locations.

Finally, the EUI and ECI of the prototype building energy models designed with the IECC-based 2023 FBC-EC and the 2024 IECC code were determined and evaluated. The weighted Florida average site EUI and ECI were calculated from the EUI and ECI of the sixteen commercial prototype buildings using weighting factors that account for the prototype building's floor area distribution by climate zones and building type. The EUI for each prototype building was determined by dividing the annual total energy use of a building by its total floor area. The ECI for each prototype building was obtained by dividing the total annual energy cost of a building by its total floor area. The total annual energy cost includes electric, demand changes, and natural gas energy costs. The standards energy rates for electricity, demand charges, and natural gas used in this analysis are provided in Appendix C.

The EUI and ECI percent difference between the 2023 FBC-EC and the 2024 IECC US national building energy code were calculated as follows:

$$\Delta X = 100 \cdot \frac{X_{FBCEC} - X_{2024IECC}}{X_{FBCEC}}$$

Where $X$ represents the EUI or ECI value of a prototype building or an aggregate of the sixteen prototype buildings, $X_{FBCEC}$ represents the EUI or ECI value of a prototype building or a weighted average of the sixteen prototype buildings of the IECC-Based 2023 FBC-EC code, and $X_{2024IECC}$ represents EUI or ECI value of a prototype building or a weighted average of the sixteen commercial prototype buildings of the 2024 IECC.

## 4.1 Prototype Buildings and Floor Area Distribution

Quantitative analysis of the Florida commercial building energy code performance was investigated using the sixteen prototype building energy models representing climate zones 1A and 2A. Figure 1 shows the commercial building's total floor area weighting factors used for Florida by prototype buildings. The eight building types and sixteen prototype energy models shown in Table 3 represent the commercial building's stock floor area and floor area distribution by prototype building in Florida.

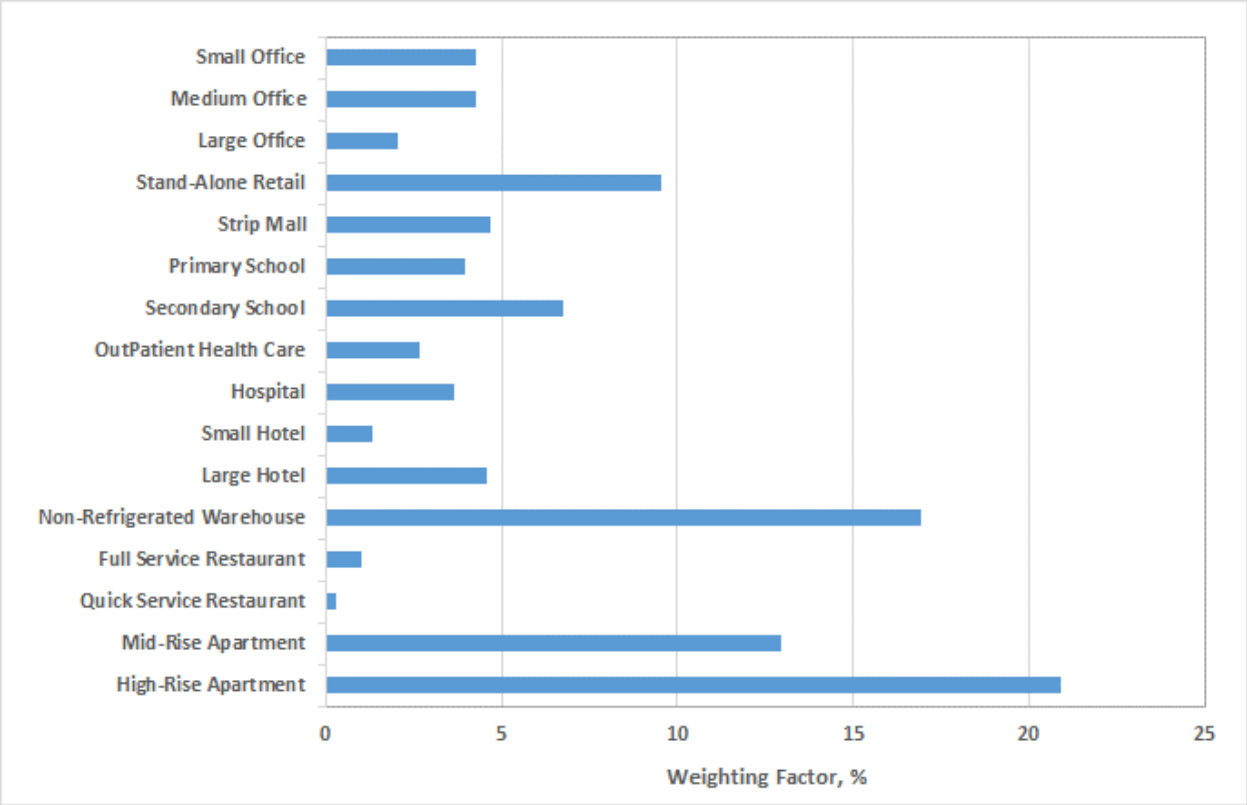


Figure 1 Commercial Prototype Buildings Type and Floor Area Distribution in Florida

The DOE uses the same prototype buildings to represent the US national commercial building stock for building energy use quantitative analysis. They claim these building types represent 75% of the US national commercial building floor area stock (Lei et al., 2020). The prototype building floor area weighting factors presented here are specific to the State of Florida and were determined as described in Appendix D.

Table 3 Commercial Prototype Buildings Type and Floor Area Distribution in Florida

| **Building Type** | **Prototype Building** | **Prototype Building Floor Area, $ft^2$** | **Total Building Floor Area, 1000 $ft^2$** | **Floor Area Weighting Factors, %** |
|---|---|---|---|---|
| Office | Small Office | 5,502 | 60,118 | 4.27 |
| | Medium Office | 53,628 | 59,533 | 4.27 |
| | Large Office | 498,588 | 28,515 | 2.06 |
| Retail | Stand-Alone Retail | 24,692 | 132,725 | 9.57 |
| | Strip Mall | 22,500 | 64,402 | 4.71 |
| Education | Primary School | 73,959 | 55,681 | 3.98 |
| | Secondary School | 210,887 | 95,221 | 6.77 |
| HealthCare | Outpatient Health Care | 40,946 | 36,318 | 2.65 |
| | Hospital | 241,501 | 51,718 | 3.68 |
| Lodging | Small Hotel | 43,202 | 16,958 | 1.33 |
| | Large Hotel | 122,120 | 64,988 | 4.57 |
| Warehouse | Non-Refrigerated Warehouse | 52,045 | 235,608 | 16.94 |
| Food Service | Full-Service Restaurant | 2,501 | 12,756 | 1.03 |
| | Quick Service Restaurant | 5,502 | 4,850 | 0.29 |
| Apartment | Mid-Rise Apartment | 33,741 | 181,057 | 12.96 |
| | High-Rise Apartment | 84,360 | 292,976 | 20.91 |
| Total | | 1,515,674 | 1393,424 | 100.00 |

# 5. Analysis of the 2023 FBCEC and 2024 IECC

This analysis compares the IECC-based 2023 FBC-EC against the 2024 IECC U.S. National Building Energy Code. Sixteen prototype building models and two climate zones were used for the energy use comparative analysis. There are 32 prototype building energy models, each representing the IECC-based 2023 FBCEC and the 2024 IECC. The analysis covers the impacts of the 2021 IECC code modifications excluded from the 2023 FBC-EC and the new code additions to the 2024 IECC. These new code additions include expanded and new additional energy efficiency measures. The quantitative analysis was conducted with and without additional energy efficiency measures.

## 5.1 Impactful 2021 IECC Changes Excluded from the 2023 FBC-EC

Prototype building models of the IECC-based 2023 FBC-EC buildings were created by modifying the 2021 IECC DOE/PNNL prototype building models. The changes to IECC-Based 2023 FBC-EC prototype buildings exclude automatic receptacle control, rolled back the U-Factor, SHG, and Visual transmittance values of vertical fenestration and skylights, swinging door U-Factor, secondary sidelight areas, and removed ERV requirements from non-transient dwelling units. The automatic receptacle control and fenestration changes impact all sixteen prototype buildings. Automatic receptacle control in the prototype building energy models was accounted for using reduced hourly fractions for receptacle loads. The change was to roll back the schedules to the base case schedule values. Table 4 summarizes five code modifications the FBC did not approve for addition to the 8$^{th}$ Edition (2023) FCBEC. These code modifications were excluded from the 2023 FBC-EC prototype building energy models.

Table 4 Impactful code changes excluded from the 2023 FBC-EC

| 2021 IECC Section and Title | Description |
|---|---|
| Table C402.1.4 Opaque Thermal Envelope Assembly Maximum Requirements, *U*-Factor Method, C402.5.1 Opaque swinging doors | Rolled back the Opaque Door U-Factor from 0.37 to 0.61 Btu/h-ft$^2$-°F. Reduced swinging doors *U*-Factor for all fourteen prototype buildings (excluding apartment buildings) in climate zones 1A and 2A. |
| Table C402.4 Building Envelope Fenestration Maximum U-Factor and SHGC Requirements | This change reverses the SHGC and *U-factor of fenestration requirements from the 2021 IECC to the 2023 FBCEC. It reduced SHGC and U-factor* of fenestrations in all sixteen prototype buildings in climate zones 1A and 2A. |
| C405.2.4.2 Sidelit daylight zone | This change removes the secondary sidelit area control requirements from the 2023 FBCEC. Impacts thirteen prototype buildings: hospital, large hotel, small hotel, large office, medium office, small office, healthcare, fast-food restaurants and full-service restaurant, Retail-Standalone, primary school, secondary school, and warehouse. |

| 2021 IECC Section and Title | Description |
|---|---|
| C405.11 Automatic Receptacle Control, C405.11.1 Automatic receptacle control function | Automatic receptacle controls are excluded from the 2023 FBC-EC. The analysis uses reduction factors to the plug load schedules to account for automatic receptacle control, which impacts all sixteen prototype buildings. |
| C403.7.4.1 Nontransient dwelling units | Removes the ERV requirement for the non-transient dwelling units from the 2023 FBCEC. Impacts high-rise and mid-rise apartment prototype buildings. |

## 5.2 Impactful Code Changes of the 2024 IECC

The 2024 IECC prototype building model energy code was created by adding new code additions to the 2021 IECC prototype building energy models. Table 5 summarizes the energy-impactful changes of the 2024 IECC included in the quantitative analysis.

Table 5 Impactful code changes added to the 2024 IECC

| ICC Code Change # | Code Change Summary b/t 2021 IECC and 2024 IECC | Discussion |
|---|---|---|
| CECPI-3-21,CEPI-58-21,CEPI-32-21,CEPI-61-21,CED1-131-22,CED1-132-22,CE2D-9-23, CEPI-71-21 | Section C402.6.2 requires whole-building air leakage testing and measurement on buildings other than R and I occupancy groups. Buildings under 25,000 ft2 of floor area in climate zones 1 and 2 must also be tested and meet the threshold of 0.35 cfm/ft2.<br><br>Advances in air leakage control technology have reduced the measured air leakage threshold to 0.35 cfm/ft$^2$ from 0.40 cfm/ft$^2$.<br><br>Whole building testing is required for buildings less than 10,000 ft$^2$, and partial testing is allowed for buildings larger than 50,000 ft$^2$. | It adds whole-building air leakage and measurement requirements and increases stringency for buildings less than 25,000 ft2 floor area.<br><br>The leakage threshold of 0.35 cfm/ft2 was applied to small offices, stand-alone retail, strip mall, outpatient Health Care, hospital hotels, warehouses, restaurants, and apartment prototype buildings. |
| CEPI-77-21 | C403.10 Buildings with high-capacity space-heating gas boiler systems. Condensing boilers are required for new construction to achieve a condensing-level efficiency of 90% for large boiler systems with a capacity between 1 and 10 MBtuh. To ensure condensing occurs, the boiler entering water must be no greater than 120°F temperature. | It increases the efficiency requirements for large boilers in new construction. This change may impact large offices, hotels, secondary schools, and prototype buildings for high-rise apartments. |
| CECPI-7-21, CEPI-135-21, CEPI-254-21 | Based on improved lighting technologies, this change reduced building area method lighting power density (LPD) allowances in Section C405.3.2 and Table C405.3.2(1). The LPD values were mostly reduced. The measure is based on improved technology with little to no impact on the construction cost. | Increased lighting efficacy due to improved LED technologies. Impacts offices prototype buildings. |
| CED1-9-22, CED1-75-22, CECPI-7-21, CEPI-135-21 | Based on improved lighting technologies, this update provides space-by-space lighting power density (LPD) values in Section C405.3.2 and Table C405.3.2(2). The interior lighting power allowance was mainly reduced, with little to no impact on the construction cost. | Increased lighting efficacy due to improved LED technologies. Impacts most prototype buildings. |
| CECD1-23-22, CEPI-189-21,CEPI-254-21 | This is a modification to Section C405.5.2 and Table C405.5.2(2) that updates the exterior lighting power allowance values. It reduces the allowances based on advances in lighting technology and aligns with ASHRAE 90.1-2022 requirements. | It reduced the exterior lighting power allowances. Impacts all the sixteen prototype buildings. |

| ICC Code Change # | Code Change Summary b/t 2021 IECC and 2024 IECC | Discussion |
|---|---|---|
| CECPI-2-21, CED1-50-22 | Adds a new subsection C405.15.1. Requires that buildings must be provided with on-site renewable electricity generation systems with a power rating of not less than 0.75 W/ft$^2$ multiplied by the sum of the gross conditioned floor area of all floors, but not to exceed the combined gross conditioned floor area of the three largest floors. Has four exceptions. This change increases the code stringency but is a cost-effective change.<br><br>Adds a minimum prescriptive requirement for on-site renewable energy. | Added on-site PV generators to all prototype buildings except the Fast-Food Restaurant prototype, exempted due to its floor size being smaller than the 5000 ft$^2$ threshold. |
| CEPI-110-21, CED1-165-22, CE2D-23-2 | Revised demand control ventilation (DCV) requirements. Modified the minimum floor area threshold for the DCV requirement by climate zones. Spaces served with heat recovery exemptions are based on climate zone and floor area; the exception now applies to small floor areas only and is, hence, more restrictive. Increase the DCV stringency for climate zones 1A and 2A. | Added DCV requirements to large offices, outpatient health care, hotels, retail, and school prototype buildings based on occupancy, floor-area size, and climate zone. School prototype building added DCV to all classrooms and other single-zone systems. |
| CEPI-108-21, CED1-168-22, CE2D-24-23 | Adds occupied standby controls per a new Section C403.7.8. This change impacts postsecondary classrooms, lecture rooms, training rooms, conference/meeting/multipurpose rooms, lounges/breakrooms, enclosed offices, open-plan office areas, and Corridor space types.<br><br>The change incurs minimal or no construction cost increase while reducing lighting and fan electric energy consumption. It is cost-effective and already included in the 2022 ASHRAE 90.1 code. | Added occupied standby control to selected spaces in nine prototype buildings. This change impacted office, school, outpatient health care, hotel, and apartment prototype buildings. |
| CEPI-193-21 | Expanded the additional energy efficiency credit options. It has renewable energy and load management plan measures as well. There are 39 measures to select to achieve the minimum required targets. The target credits vary by building type and climate zones. | This change impacts all sixteen prototype buildings. The and the |

## 5.3 Quantitative Analysis Results without Additional Efficiency

Quantitative analysis was conducted with and without the additional efficiency measures. The quantitative analysis results with additional efficiency measures included are presented in Section 5.5. This section covers the quantitative analysis without the additional efficiency measure. These results can be used as a reference to assess the relative impact of the additional energy efficiency measures on the energy code. Table 6 shows the annual site EUI values determined without the additional energy efficiency measures. Florida's average EUI was 43.06 kBtu/ft$^2$-yr and 41.56 kBtu/ft$^2$-yr for the IECC-based 2023 FBC-EC and the 2024 IECC, respectively. Florida's average EUI of the IECC-based 2023 FBC-EC was higher by 3.49% relative to the 2024 IECC Building Energy Code.

Table 6 Site EUI without Additional Energy Efficiency Measures By Prototype Building

| **Building Type** | **Weighting Factors, %** | **IECC Based 2023 FBCEC EUI, kBtu/ft$^2$-yr** | **2024-IECC EUI, kBtu/ft$^2$-yr** | **ΔEUI, %** |
|---|---|---|---|---|
| Small Office | 4.27 | 29.55 | 27.68 | 6.31 |
| Medium Office | 4.27 | 31.54 | 29.41 | 6.74 |
| Large Office | 2.06 | 53.69 | 51.65 | 3.80 |
| Stand-Alone Retail | 9.57 | 38.00 | 37.14 | 2.25 |
| Strip Mall | 4.71 | 42.79 | 36.48 | 14.73 |
| Primary School | 3.98 | 48.63 | 45.96 | 5.50 |
| Secondary School | 6.77 | 49.08 | 47.55 | 3.12 |
| Outpatient Health Care | 2.65 | 105.36 | 103.98 | 1.30 |
| Hospital | 3.68 | 117.16 | 113.27 | 3.32 |
| Small Hotel | 1.33 | 53.13 | 51.98 | 2.17 |
| Large Hotel | 4.57 | 80.36 | 79.50 | 1.06 |
| Non-Refrigerated Warehouse | 16.94 | 7.50 | 7.20 | 4.01 |
| Quick Service Restaurant | 1.03 | 457.75 | 455.56 | 0.48 |
| Full Service Restaurant | 0.29 | 312.64 | 309.16 | 1.11 |
| Mid-Rise Apartment | 12.96 | 31.60 | 30.64 | 3.03 |
| High-Rise Apartment | 20.91 | 33.55 | 32.35 | 3.58 |
| Weighted Florida Average | 100.00 | 43.06 | 41.56 | 3.49 |

Table 7 Summarizes the annual site operating Energy Cost Index (ECI) without the additional energy efficiency measure by building type. These values do not include the additional energy efficiency measures in the analysis. The IECC-based 2023 FBC-EC and the 2024 IECC Florida average ECI were 1.21 $/ft$^2$-yr and 1.08 $/ft$^2$-yr, respectively. The operating energy cost analysis demonstrated that the annual energy cost index of the IECC-based 2023 FBCEC, a modified version of the 2021 IECC, was higher by about 10.52%.

Table 7 Site ECI without Additional Energy Efficiency Measures By Prototype Building

| Building Type | Weighting Factors, % | IECC Based 2023 FBCEC ECI, $/ft$^2$-yr | 2024-IECC ECI, $/ft$^2$-yr | ΔECI, % |
|---|---|---|---|---|
| Small Office | 4.27 | 0.92 | 0.75 | 17.67 |
| Medium Office | 4.27 | 0.95 | 0.77 | 19.04 |
| Large Office | 2.06 | 1.64 | 1.55 | 5.23 |
| Stand-Alone Retail | 9.57 | 1.11 | 0.97 | 12.60 |
| Strip Mall | 4.71 | 1.33 | 1.02 | 23.39 |
| Primary School | 3.98 | 1.38 | 1.17 | 15.01 |
| Secondary School | 6.77 | 1.41 | 1.24 | 11.86 |
| Outpatient Health Care | 2.65 | 2.74 | 2.58 | 5.84 |
| Hospital | 3.68 | 2.96 | 2.82 | 4.73 |
| Small Hotel | 1.33 | 1.34 | 1.22 | 8.80 |
| Large Hotel | 4.57 | 2.09 | 2.01 | 3.83 |
| Non-Refrigerated Warehouse | 16.94 | 0.23 | 0.12 | 47.18 |
| Quick Service Restaurant | 1.03 | 9.19 | 9.12 | 0.76 |
| Full Service Restaurant | 0.29 | 7.08 | 6.86 | 3.15 |
| Mid-Rise Apartment | 12.96 | 0.98 | 0.87 | 10.79 |
| High-Rise Apartment | 20.91 | 1.03 | 0.97 | 6.46 |
| Weighted Florida Average | 100.00 | 1.21 | 1.08 | 10.52 |

The ECI values of the 2024 IECC are much lower than the 2023 FBC-EC for two reasons: (1) due to energy-efficient new codes changes introduced to the 2024 IECC, and (2) the net metering of the on-site generated renewable energy reduces the operating energy cost compared to the 2023 FBC-EC.

## 5.4 Additional Energy Efficiency Measures

Table 8 summarizes the 2024 IECC additional energy credit requirements by building occupancy group and climate zone per Section Table C406.1.1(1). Nine building occupancy groups were used to represent the additional efficiency requirement in the sixteen prototype buildings.

Table 8 Target Energy Credits by Building Occupancy Group and Climate Zone

| Building Occupancy Group | 1A | 2A |
|---|---|---|
| Apartment (R2, R-4, and I-1) | 67 | 80 |
| Hospital (I-2) | 38 | 36 |
| Hotel / Motel (R-1) | 66 | 70 |
| Outpatient Clinic (B) | 64 | 66 |
| Restaurant (A-2) | 72 | 75 |
| Retail (M) | 83 | 81 |
| Schools (E) | 55 | 58 |
| Warehouse (S-1 and S-2) | 61 | 58 |
| Office (All Other) | 31 | 32 |

The IECC-based 2023 FBC has seven additional efficiency measures, but only a 10% cooling efficiency increase measure was used across all the sixteen prototype buildings.

The 2024 IECC expanded the additional efficiency measures to 39 measures from 11 measures in the 2021 IECC. The target additional energy efficiency credits depend on the building occupancy group and climate zones. To meet the target energy efficiency credits, 3 to 9 combinations of additional efficiency measures were selected depending on building occupancy groups and climate zones. The achievable energy credits are determined by selecting measures that can be implemented and represented in the prototype buildings. Table 9 summarizes the additional energy efficiency measures included in the 2024 IECC model energy code analysis for each prototype building. The details of the additional efficiency measures used by the building occupancy group and climate zones are summarized in Appendix B.

Table 9 Additional Efficiency Measures for the 2024 IECC

| | Apartment (R2, R-4, and I-1) | Hospital (I-2) | Hotel / Motel (R-1) | Outpatient Clinic (B) | Restaurant (A-2) | Retail (M) | Schools (E) | Warehouse (S-1 and S-2) | Office (All Other) |
|---|---|---|---|---|---|---|---|---|---|
| Reduced Air Leakage (E03) | x | | x | x | | | | x | |
| Add Roof Insulation (E04) | | | | | | x | | | |
| Add Wall Insulation (E05) | | | | | | x | x | | |
| Improve Fenestration (E06) | | | x | x | | | x | | |
| Cooling Efficiency (H03) | x | x | x | x | x | x | x | x | x |
| Heat Pump Water Heater (W02) | x | | x | | x | | | | |
| Efficient Gas Water Heater (W03) | | | x | x | x | | x | | |
| Commercial Kitchen Equipment (Q03) | | | | | x | | | | |
| Lighting Occupancy Sensor (L03) | | x | x | x | | | | | |
| Reduced Lighting Power (L06) | | x | x | x | x | x | x | x | x |
| Renewable Energy (R01) | | x | x | x | x | x | x | x | x |

## 5.5 Quantitative Analysis Results with Additional Energy Efficiency

The Energy Utilization Intensity (EUI) of each prototype building for each climate zone was aggregated by Florida climate zone floor area weighing factors to determine the EUI by prototype building. The Florida commercial buildings' stock floor area distribution by the building type and climate zones were derived from the latest PNNL report (Lei et al., 2020). The energy performance of the IECC-based 2023 FBC-EC was determined by comparing the annual site EUIs against the 2024 IECC by prototype buildings.

Figure 2 and Table 10 show the annual site EUI plots of the IECC-based 2023 FBCEC and the 2024 IECC standard by prototype buildings. As expected, the IECC-based 2023 FBCEC prototype building models use more energy than the 2024 IECC Building Energy Code. Florida's average EUI was 42.48 kBtu/ft$^2$-yr and 39.19 kBtu/ft$^2$-yr for the IECC-based 2023 FBC-EC and the 2024 IECC, respectively. Florida's average EUI of the IECC-based 2023 FBC-EC was higher by about 7.76% relative to the 2024 IECC Building Energy Code.

Figure 3 and Table 11 show the annual site Energy Cost Index (ECI) of the IECC-based 2023 FBC-EC and the 2024 IECC by prototype buildings. The annual operating energy cost index comparison is for each of the sixteen prototype buildings and a weighted average value for the state. The IECC-based 2023 FBC-EC and the 2024 IECC average operating Energy Cost Index (ECI) were 1.19 \$/ft$^2$-yr and 1.01 \$/ft$^2$-yr, respectively. The operating energy cost analysis demonstrated that the annual energy cost index of the IECC-based 2023 FBCEC, a modified version of the 2021 IECC, was higher by about 15.22 percent. In other words, the 2024 IECC shows 7.76 percent and 15.22 percent energy use and operating energy cost savings, respectively, relative to the IECC-based 2023 FBCEC.

The IECC-based 2023 FBC-EC prototype building energy models consume more energy in one part due to the exclusion of code modifications listed in Table 4 and in another part due to the new code modifications and additional energy efficiency measures (listed in Table 5) added to the 2024 IECC. Furthermore, the 2024 IECC includes on-site renewable energy generation requirements, reducing operating energy costs due to net metering. Therefore, if equivalency is desired, the IECC-based 2026 (9$^{th}$ Edition) FBC-EC must catch up with the 2024 IECC and consider adding the energy-impactful excluded code modifications.

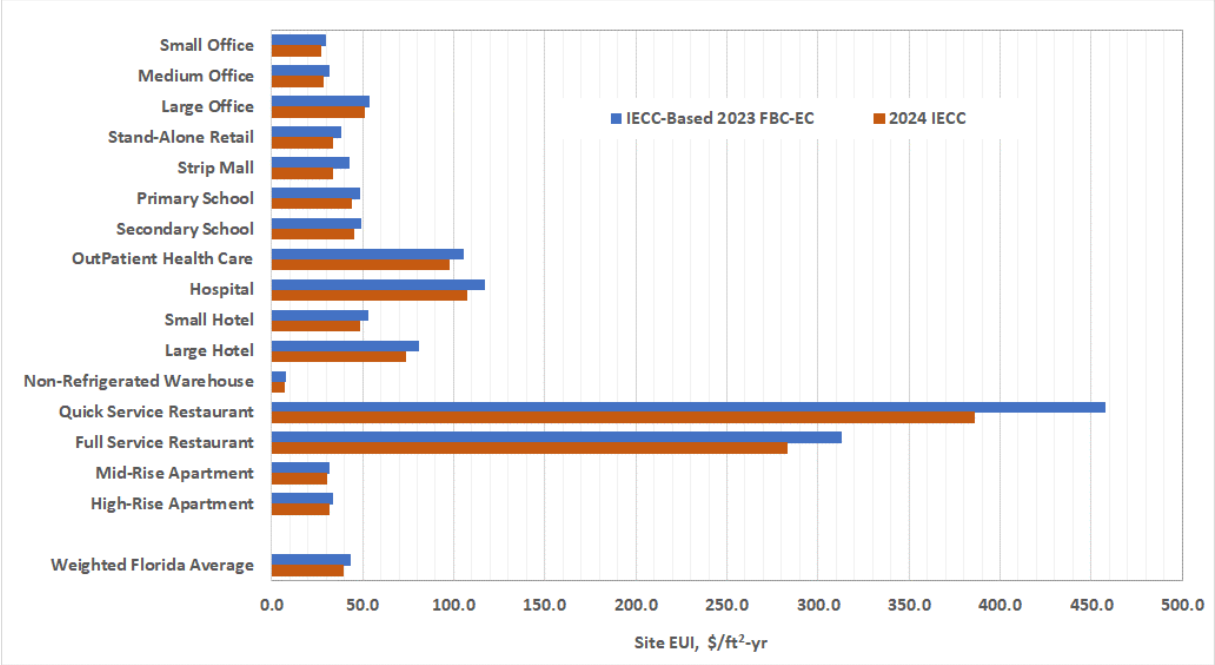


Figure 2 EUI of the IECC-Based 2023 FBC-EC and the 2024 IECC by Prototype Building

Table 10 Site EUI of the IECC-Based 2023 FBC-EC and IECC-2024 by Prototype Building

| Building Type | Weighting Factors, % | IECC Based 2023 FBCEC EUI, kBtu/ft²-yr | 2024-IECC EUI, kBtu/ft²-yr | ΔEUI, % |
|---|---|---|---|---|
| Small Office | 4.27 | 28.88 | 26.83 | 7.09 |
| Medium Office | 4.27 | 31.00 | 28.38 | 8.45 |
| Large Office | 2.06 | 53.1 | 50.86 | 4.21 |
| Stand-Alone Retail | 9.57 | 36.9 | 33.64 | 8.82 |
| Strip Mall | 4.71 | 40.93 | 33.56 | 18.02 |
| Primary School | 3.98 | 47.94 | 43.51 | 9.23 |
| Secondary School | 6.77 | 48.3 | 44.99 | 6.86 |
| Outpatient Health Care | 2.65 | 104.42 | 97.56 | 6.58 |
| Hospital | 3.68 | 115.7 | 107.35 | 7.21 |
| Small Hotel | 1.33 | 52.48 | 48.45 | 7.68 |
| Large Hotel | 4.57 | 79.86 | 73.39 | 8.11 |
| Non-Refrigerated Warehouse | 16.94 | 7.3 | 6.88 | 5.66 |
| Quick Service Restaurant | 1.03 | 456.47 | 386.05 | 15.43 |
| Full Service Restaurant | 0.29 | 311.35 | 282.67 | 9.21 |
| Mid-Rise Apartment | 12.96 | 31.38 | 29.92 | 4.65 |
| High-Rise Apartment | 20.91 | 33.3 | 31.44 | 5.59 |
| Weighted Florida Average | 100.00 | 42.48 | 39.19 | 7.76 |

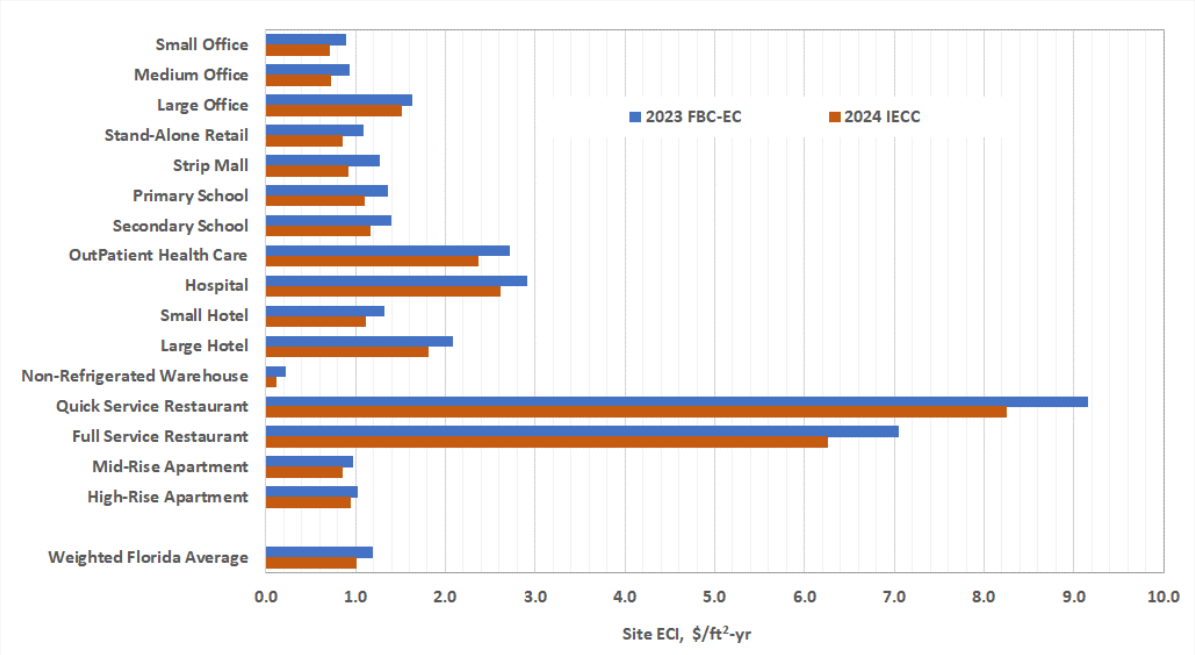


Figure 3 ECI of the IECC-Based 2023 FBC-EC and the 2024 IECC by Prototype Building

Table 11 Site ECI of the IECC-Base 2023 FBC-EC and IECC-2024 by Prototype Building

| Building Type | Weighting Factors, % | IECC-Based 2023 FBCEC ECI, $/ft²-yr | IECC-2024 ECI, $/ft²-yr | ΔECI, % |
|---|---|---|---|---|
| Small Office | 4.27 | 0.90 | 0.71 | 20.30 |
| Medium Office | 4.27 | 0.93 | 0.72 | 22.21 |
| Large Office | 2.06 | 1.63 | 1.51 | 7.10 |
| Stand-Alone Retail | 9.57 | 1.08 | 0.85 | 21.18 |
| Strip Mall | 4.71 | 1.27 | 0.91 | 27.78 |
| Primary School | 3.98 | 1.36 | 1.09 | 19.66 |
| Secondary School | 6.77 | 1.39 | 1.16 | 16.37 |
| Outpatient Health Care | 2.65 | 2.71 | 2.37 | 12.62 |
| Hospital | 3.68 | 2.91 | 2.61 | 10.22 |
| Small Hotel | 1.33 | 1.32 | 1.11 | 15.75 |
| Large Hotel | 4.57 | 2.08 | 1.81 | 12.70 |
| Non-Refrigerated Warehouse | 16.94 | 0.22 | 0.11 | 50.70 |
| Quick Service Restaurant | 1.03 | 9.15 | 8.24 | 9.95 |
| Full Service Restaurant | 0.29 | 7.04 | 6.26 | 11.13 |
| Mid-Rise Apartment | 12.96 | 0.97 | 0.85 | 11.93 |
| High-Rise Apartment | 20.91 | 1.02 | 0.94 | 8.47 |
| Weighted Florida Average | 100.00 | 1.19 | 1.01 | 15.22 |

## 5.6 Quantitative Analysis Results with PAEC Adjustment

The IECC-based code requires a percentage of the standard reference design's annual energy cost for the simulated building performance compliance method. The 2023 FBC-EC requires an 85% annual energy cost of the standard reference design for compliance. The 2024 IECC does not use a fixed percentage. Instead, it varies based on the additional energy credits achieved. The equation below calculates the PAEC values by building occupancy groups and climate zones for the 2024 IECC. The energy efficiency credits used to adjust the PAEC values are provided in Appendix B.

$$PAEC = 100 \times (0.80 + 0.25 - EC_r/1000)$$

Where:

*PAEC* = The percentage of the annual energy cost of the standard reference design.

$EC_r$ = Energy efficiency credits required for the building in accordance with Section C406.1 (don't include load management and renewable credits).

Table 12 summarizes the PAEC values calculated by building occupancy group and climate zone for the 2024 IECC. The PAEC adjustment was applied to the annual energy utilization intensity (EUI) and energy cost index (ECI).

Table 12 Percentage of the Annual Energy Cost of the Standard Reference Design

| Building Type | 2023 FBC-EC | | 2024 IECC | |
|---|---|---|---|---|
| | 1A | 2A | 1A | 2A |
| Office | 85 | | 80.7 | 80.9 |
| Warehouse | | | 78.1 | 78.3 |
| Apartments | | | 75.5 | 74.1 |
| Hospital | | | 79.0 | 79.4 |
| Outpatient | | | 77.7 | 77.5 |
| Hotel | | | 77.1 | 76.4 |
| Fast-Food Restaurant | | | 75.3 | 75.0 |
| Sit-Down Restaurant | | | 75.5 | 75.2 |
| Retail | | | 74.9 | 75.5 |
| School | | | 78.3 | 77.9 |

Table 13 shows the annual site EUI values adjusted using the PAEC values from Table 12. Similarly, Table 14 shows the annual site ECI values adjusted for PAEC. Florida's average EUI was 36.60 kBtu/ft$^2$-yr and 31.90 kBtu/ft$^2$-yr for the IECC-based 2023 FBC-EC and the 2024 IECC, respectively. Florida's average EUI of the IECC-based 2023 FBC-EC was higher by about 12.86% relative to the 2024 IECC Building Energy Code. The IECC-based 2023 FBC-EC and the 2024 IECC average operating Energy Cost Index (ECI) were 1.03 \$/ft$^2$-yr and 0.83 \$/ft$^2$-yr, respectively. The operating energy cost analysis shows that the annual energy cost index of the IECC-based 2023 FBCEC was higher by about 19.25%. The EUI and ECI values of the 2024 IECC are much lower than the 2023 FBC-EC for two reasons: (1) the EUI and ECI values are already lower due to the energy-efficient codes changes introduced to the 2024 IECC, and (2) the 2024 IECC PAEC values are lower compared to that of the 2023 FBC-EC.

Table 13 Site EUI with PAEC Adjustment By Prototype Building

| Building Type | Weighting Factors, % | IECC Based 2023 FBCEC EUI, kBtu/ft$^2$-yr | 2024-IECC EUI, kBtu/ft$^2$-yr | ΔEUI, % |
|---|---|---|---|---|
| Small Office | 4.27 | 25.11 | 22.38 | 10.87 |
| Medium Office | 4.27 | 26.81 | 23.77 | 11.31 |
| Large Office | 2.06 | 45.64 | 41.73 | 8.58 |
| Stand-Alone Retail | 9.57 | 32.30 | 27.99 | 13.34 |
| Strip Mall | 4.71 | 36.37 | 27.48 | 24.44 |
| Primary School | 3.98 | 41.34 | 35.84 | 13.29 |
| Secondary School | 6.77 | 41.72 | 37.09 | 11.09 |
| Outpatient Health Care | 2.65 | 89.55 | 80.62 | 9.97 |
| Hospital | 3.68 | 99.58 | 89.82 | 9.80 |
| Small Hotel | 1.33 | 45.16 | 39.80 | 11.88 |
| Large Hotel | 4.57 | 68.30 | 60.94 | 10.78 |
| Non-Refrigerated Warehouse | 16.94 | 6.37 | 5.63 | 11.65 |
| Quick Service Restaurant | 1.03 | 389.09 | 341.67 | 12.19 |
| Full Service Restaurant | 0.29 | 265.74 | 232.76 | 12.41 |
| Mid-Rise Apartment | 12.96 | 26.86 | 22.83 | 14.99 |
| High-Rise Apartment | 20.91 | 28.52 | 24.29 | 14.84 |
| Weighted Florida Average | 100.00 | 36.60 | 31.90 | 12.86 |

Table 14 Site ECI with PAEC Adjustment By Prototype Building

| Building Type | Weighting Factors, % | IECC Based 2023 FBCEC ECI, $/ft$^2$-yr | 2024-IECC ECI, $/ft$^2$-yr | ΔECI, % |
|---|---|---|---|---|
| Small Office | 4.27 | 0.78 | 0.61 | 21.68 |
| Medium Office | 4.27 | 0.80 | 0.62 | 23 |
| Large Office | 2.06 | 1.39 | 1.26 | 9.93 |
| Stand-Alone Retail | 9.57 | 0.94 | 0.73 | 22.52 |
| Strip Mall | 4.71 | 1.13 | 0.76 | 32.11 |
| Primary School | 3.98 | 1.17 | 0.91 | 22.02 |
| Secondary School | 6.77 | 1.20 | 0.97 | 19.11 |
| Outpatient Health Care | 2.65 | 2.33 | 2.00 | 14.11 |
| Hospital | 3.68 | 2.51 | 2.23 | 11.12 |
| Small Hotel | 1.33 | 1.14 | 0.93 | 17.85 |
| Large Hotel | 4.57 | 1.78 | 1.54 | 13.27 |
| Non-Refrigerated Warehouse | 16.94 | 0.20 | 0.10 | 51.39 |
| Quick Service Restaurant | 1.03 | 7.81 | 6.84 | 12.44 |
| Full Service Restaurant | 0.29 | 6.02 | 5.17 | 14.21 |
| Mid-Rise Apartment | 12.96 | 0.83 | 0.65 | 21.79 |
| High-Rise Apartment | 20.91 | 0.88 | 0.73 | 17.38 |
| Weighted Florida Average | 100.00 | 1.03 | 0.83 | 19.25 |

# 6. Cost-Effectiveness Analysis of the 2024 IECC Changes

A cost-effectiveness test was conducted for code modifications between the IECC-based 2023 FBC-EC and 2024 IECC. The cost-effectiveness analysis used annual energy savings determined between the base case, the 8th Edition (2023) Florida Building Code, Energy Conservation, and the 2024 IECC. This requires creating a separate baseline and upgrading the code prototype building energy model for each code modification whose energy savings potential can be determined from building energy models and simulations. The life cycle energy costs and operating energy savings were computed using Florida energy rates for electricity and natural gas, and the energy price escalation rates for the U.S. southeast region are summarized in Appendix C.

The code modification, along with a brief description of the code changes, energy, and construction cost impacts, are provided in Appendix A. Code modifications whose energy impact cannot be analyzed quantitatively, code modifications with no or negligible incremental construction cost, federally enforced minimum code requirements, or those code changes cannot be represented in the existing prototype buildings model are excluded from cost-effectiveness analysis. Details of the cost-effectiveness analysis and results for selected measures are provided in Appendix E.

## 6.1 Cost-Benefit Analysis of Code Modifications

A cost-benefit analysis of selected code modifications was performed by calculating the savings-to-investment ratio (SIR). SIR is the ratio of the net present value of the energy savings over a service life span to the net present value of the life cycle cost of the investment. The net energy cost savings and net investment cost were determined from the difference between the IECC-based 2023 FBC-EC and the 2024 IECC.

In the cost-benefit analysis, a constant dollar approach with a real discount rate of 5.0% was assumed for the baseline and upgrade life cycle cost calculation. The net present value of operating energy cost and the net present value of their investment cost were determined using EnergyPlus, Whole Building Simulation Software. The SIR values were determined by processing the EnergyPlus outputs. SIR value less than 1.0 means the net life cycle investment cost exceeds the net life cycle operating energy cost savings of the code upgrade; hence, it is considered not economical or not cost-effective.

## 6.2 IECC Changes Cost-Benefit Analysis Summary

Out of the six code modifications investigated for cost-effectiveness for the 2024 IECC changes, five had an SIR value greater than 1.0; hence, they are considered economically feasible and are recommended for consideration by the Florida Building Commission in addition to the 9th Edition (2026) Florida Building Code, Energy Conservation. Table 15 summarizes the cost-benefit test results estimated for each of the six code modifications investigated.

Table 15 IECC 2024 Code Modification Cost-Effectiveness Test Results Summary

| Code Mod # | Code Section # and Brief Description of Proposed Code Modifications | Savings to Investment Ratio (SIR) |
|---|---|---|
| **CEPI-110-21** | **C403.7.1 Demand Control Ventilation**<br>The 2024 IECC revised the demand-controlled ventilation requirements. In section C403.7.1 Demand control ventilation, the 2021 and 2024 IECC people occupancy density threshold for demand control ventilation is 15 people or greater per 1,000 $ft^2$ of floor area. In contrast, the 2023 FBC-EC people occupancy density threshold demand control ventilation is 25 people or greater per 1,000 $ft^2$ of floor area. The 2024 IECC requires demand control ventilation in spaces with an occupant density of 15 people or greater per 1,000 $ft^2$. However, spaces served by a single-zone system are not required to meet the occupant density threshold. Still, they require DCV so long as the single zone system has an air-economizer and does not have an energy recovery system. Demand-control ventilation is a requirement in spaces with air economizers, but there are exceptions depending on the space's floor area, occupant density, and energy recovery. The floor area threshold for exemption is dependent on the climate zone.<br><br>The cost-effectiveness of demand control ventilation requirements was investigated. The weighted average SIR across the retail and secondary school prototype buildings was 3.47, which is cost-effective. Therefore, the demand control ventilation change meets the cost-benefit criteria and is recommended for addition to the 9th Edition (2026) Florida Building Code, Energy Conservation. | 1.19 – 7.32 |

| Code Mod # | Code Section # and Brief Description of Proposed Code Modifications | Savings to Investment Ratio (SIR) |
|---|---|---|
| **CEPI-108-21** | **C403.7.8 Occupied Standby Controls**<br>Add a new definition for "occupied standby mode" and new ventilation air requirements for zones in occupied standby mode. This code changes cooling and heating thermostats by at least 1.0°F (0.56°C) for zones served in occupied standby mode. It reduces the zone ventilation air requirement to zero (shuts off the supply air) when the space temperature floats between the heating and cooling set points. Furthermore, this code change is intended to tie occupied-standby mode to occupant sensor lighting control requirement in section C405.2.1, i.e., when a space is not occupied for more than 20 minutes, lighting is turned off automatically. In summary, there are two changes for "occupied-standby controls":<br>• Set the heating thermostat back or set the cooling thermostat up by 1.0 °F when the space is planned for "occupied-standby mode."<br>• Turn off ventilation air supply when a space is planned for "occupied-standby mode" for a single zone or a multi-zone system<br><br>A cost-benefit analysis demonstrated that the weighted average SIR value for the small office, small hotel, and primary school prototype buildings is 1.70; hence, this code change is cost-effective. Therefore, it is recommended that the Florida Building Commission consider this change for addition to the 9th Edition (2026) Florida Building Code, Energy Conservation. | 0.70- 5.97 |

| Code Mod # | Code Section # and Brief Description of Proposed Code Modifications | Savings to Investment Ratio (SIR) |
|---|---|---|
| **CEPI-77-21** | **C403.10 Buildings with High-Capacity Space-Heating Gas Boiler System**<br>This code modification is a new requirement for high-capacity space-heating condensing gas boilers per Section C403.10 and subsections C403.10.1 and C403.10.2. These modifications require a condensing gas boiler and hot water distribution system that enables lower return water temperature and higher thermal efficiency for a high-capacity space-heating boiler. In summary, there are two changes for high-capacity space-heating boiler systems:<br>• Increase the thermal efficiency of condensing gas boiler to 90% for space heating applications with a capacity range from 1.0 million Btu/r to 10.0 million Btu/h per section C403.10.1.<br>• In the design and all operating conditions, the return water temperature must not exceed 120°F per Section C403.10.2.<br><br>The cost-benefit analysis demonstrated that the average SIR value for the large office, secondary school, and hospital prototype buildings is 1.18. This code modification is more favorable in climate zone 2A than 1A. It is cost-effective in building occupancy groups that operate 24 hours, such as hospital buildings. Therefore, depending on the building occupancy group, this code change is recommended for addition to the 9th Edition (2026) Florida Building Code, Energy Conservation. | 0.03 - 2.30 |
| **CECPI-7-21** | **Interior Lighting Power Density Reduction**<br>The 2024 IECC reduces the interior lighting power density (LPD) for the building area method in Table C405.3.2(1). The building area method LPD values were reduced for all building area types except the convention center, exercise center, fire station, library, manufacturing facility, and warehouse. The code change also reduces the interior lighting power density (LPD) for the space-by-space method in Table C405.3.2(2). The LPD values were reduced for most space types.<br><br>The cost-effectiveness analysis of interior lighting power density (LPD) reduction was based on a 15-year service life of LED technology for the baseline and upgrade scenarios. | 1.88 – 7.09 |

| Code Mod # | Code Section # and Brief Description of Proposed Code Modifications | Savings to Investment Ratio (SIR) |
|---|---|---|
| | The first installed incremental cost was used for the analysis since the baseline and upgrade are based on 100% LED technology. The weighted average SIR value for the commercial sector across the eight prototype buildings in Florida climate estimated was about 3.86, which is cost-effective. Therefore, this code modification is recommended for addition to the 9th Edition (2026) Florida Building Energy Code, Energy Conservation. | |
| **CEPI-189-21** | **Exterior Lighting Power Allowance Reduction**<br>The 2024 IECC reduces the exterior site lighting power allowances and exterior lighting power density allowances for building facades, entrances, and parking lots per Tables C405.5.2(1) and C405.5.2(2). The base site allowance was reduced by 20% to 54%, depending on the exterior lighting zone. The exterior lighting allowance for parking lots, building entrances, and building exterior walls is also significantly reduced. The total exterior lighting allowance reduction between the 2023 FBC-EC and the 2024 IECC ranges from 23% to 34%, depending on the prototype buildings.<br><br>The cost-effectiveness analysis of exterior lighting allowance reduction was based on a 15-year service life of LED technology for the baseline and the upgrade scenarios. Since the baseline and upgrade are based on 100% LED technology, the installed incremental cost was used for the analysis. The weighted average SIR value for the commercial sector across the six prototype buildings in Florida climate estimated was about 2.02, which is cost-effective. Therefore, this code modification is recommended for addition to the 9th Edition (2026) Florida Building Energy Code, Energy Conservation. | 1.92 – 7.09 |

| Code Mod # | Code Section # and Brief Description of Proposed Code Modifications | Savings to Investment Ratio (SIR) |
|---|---|---|
| **CED1-50-22** | **C405.15.1 On-Site Renewable Energy System**<br>Adds a minimum prescriptive requirement for on-site renewable energy generation per Section C405.15.1. Requires that buildings must be provided with on-site renewable electricity generation systems with a power rating of not less than 0.75 W/ft$^2$ multiplied by the sum of the gross conditioned floor area of all floors, but not to exceed the combined gross conditioned floor area of the three largest floors. This requirement impacts all but the fast-food prototype building due to the floor area threshold of 5,000 ft$^2$ per one of the exceptions. Photovoltaic DC power generators were added to all prototype buildings with the minimum requirements. The PV has a DC-AC inverter and runs as a base-load generator. All the PV arrays were mounted with optimal slope, i.e., the slope matching the site latitude angle.<br><br>The cost-effectiveness of the on-site renewable energy generators was investigated in all illegible prototype buildings in climate zones 1A and 2A. The average SIR across the two climate zones and fifteen prototype buildings determined without incentives ranges from 0.94 to 1.10, and the weighted average SIR across all sixteen prototype buildings is 1.07, which is cost-effective. Therefore, the on-site renewable energy generation prescriptive minimum requirement (0.75 W/ft$^2$ ) without the incentives is marginally cost-effective. With incentives applied, the weighted average SIR of prototype buildings in the two climate zones ranges from 1.08 to 1.32, and the weighted average SIR of all sixteen prototype buildings is 1.26, which is cost-effective. | 0.94 - 1.10 (without incentives)<br><br>1.08 - 1.32 (with incentives) |

## 7. Summary and Conclusion

The Florida commercial code provisions change analysis was conducted between the IECC-based 2023 FBC-EC code and the 2024 IECC. The analysis was conducted with attention to detail, ensuring the accuracy and reliability of the findings. The findings are presented next.

A comprehensive review of the changes between the IECC-based 2023 FBC-EC and the 2024 IECC code draft was conducted and summarized. The review also identified the impacts of the changes in energy and construction costs. Appendix A summarizes the details of the listing of the code changes with and without energy impact and a brief description of each code change, providing insight into the changes' construction cost impacts. There are 238 code changes introduced into the draft 2024 IECC, and ninety-four have direct or indirect energy impacts. Mechanical systems, lighting, and additional energy efficiency measures account for 89% of the code changes with an energy impact. Twenty of the ninety-four code changes with direct and indirect energy impact were included in the quantitative analysis.

Three scenarios of comparative analysis between the IECC-based 2023 FBC-EC and the 2024 IECC were conducted: (1) quantitative analysis without additional efficiency measures, (2) quantitative analysis with additional efficiency measures, and (3) quantitative analysis without additional efficiency measures and PACE adjustment. The Florida weighted average site Energy Utilization Intensity (EUI) determined for the three scenarios is summarized in Table 16. The results demonstrate that the annual site EUI of the IECC-based 2023 FBCEC, a modified version of the 2021 IECC, is higher than that of the 2024 IECC for the three scenarios. The quantitative analysis results aggregated across the commercial building sector show that the IECC-based 8th Edition (2023) Commercial FBC-EC lags behind the 2024 IECC Building Energy Code due to three main reasons: (1) the exclusion of a selected Section of the 2021 IECC requirements such as automatic receptacle control, fenestration and skylight upgrade, secondary sidelight area from the 2023 FBEC-EC, (2) adding energy-impactful new code modifications including expanded additional energy efficiency measures to the 2024 IECC, and (3) on-site renewable energy generation requirement added to the 2024 IECC.

Table 16 Florida Average Site EUI of the IECC-Based 2023 FBC-EC and the 2024 IECC

| | IECC-Based 2023 FBC-EC, kBtu/ft$^2$-yr | IECC-2024, kBtu/ft$^2$-yr | EUI Difference, % |
|---|---|---|---|
| Without Additional Energy Efficiency Measures | 43.06 | 41.56 | 3.49 |
| With Additional Energy Efficiency Measures | 42.40 | 39.10 | 7.76 |
| Without Additional Energy Efficiency Measures and PAEC Adjustment | 36.60 | 31.90 | 12.86 |

The quantitative analysis also included an operating energy cost comparison between the IECC-based 2023 FBC-EC and the 2024 IECC codes across the sixteen prototype buildings. The Florida weighted average Energy Cost Index (ECI) determined for the three analysis scenarios is summarized in Table 17. The operating energy cost analysis demonstrated that the annual energy cost index of the IECC-based 2023 FBCEC, a modified version of the 2021 IECC, was higher than that of the 2024 IECC for all three scenarios. The much lower operating energy cost of the 2024 IECC is partly due to the addition of energy-impactful code modifications and, in another part, due to net metering of on-site generated renewable energy.

Table 17 Florida Average Site ECI of the IECC-Based 2023 FBC-EC and the 2024 IECC

| | **IECC-Based 2023 FBC-EC, $/ft$^2$-yr** | **IECC-2024, $/ft$^2$-yr** | **ECI Difference, %** |
|---|---|---|---|
| Without Additional Energy Efficiency Measures | 1.21 | 1.08 | 10.52 |
| With Additional Energy Efficiency Measures | 1.19 | 1.01 | 15.22 |
| Without Additional Energy Efficiency Measures and PAEC Adjustment | 1.03 | 0.83 | 19.25 |

Qualitative and quantitative cost-benefit analysis of the code modifications added to the 2024 IECC code changes were conducted. The qualitative cost-effectiveness analysis covered code changes with significant energy impacts. And quantitative cost-benefit analysis was conducted for selected code modifications whose impacts can be determined using building energy performance simulation programs. The additional energy efficiency measures were not included in the quantitative cost-effectiveness analysis. Therefore, based on the qualitative and quantitative analysis conducted if code equivalency is the desired target, then the 9$^{th}$ Edition (2026) FBC-EC must catch up with the 2024 IECC Building Energy Code and consider adding some of the code modifications excluded from the 2023 FBC-EC.

## 8. Reference

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## Appendix-A: Commercial Code Change for 8th Edition (2023) FBCEC vs. 2024 IECC

Table A summarizes commercial 2024 IECC energy and construction cost changes with respect to 2021 IECC and the 8th Edition (2023) Florida Building Code Energy Conservation (FBCEC). The table has six columns, each defined as follows.

**2024 IECC Section and Title**: is the code Section and title for the 2024 IECC.

**ICC Code Change No**: Proposed code change number in the ICC's *Complete Revision History to the 2024 I-Codes* draft document.

**Change Summary b/t 2021 IECC and 2024 IECC**: a brief description of the code change between the 2021 IECC and the draft 2024 IECC. The description also includes construction costs and code stringency changes. Also, note if the changes are cost-effective based on qualitative and quantitative analysis.

**Change Summary b/t 2023 FBC-EC and 2021 IECC**: a brief description of the code change between the 2023 FBC-EC and 2024 IECC.

**Anticipated Energy Impact on FBCEC if Adopted**: Anticipated energy use impact from the code change if adopted in the FBCEC. This is usually a decrease in energy use, an increase in energy use, or none. "None" means the code change has no or negligible impact on energy use.

**Anticipated Cost Impact on FBC-EC if Adopted**: Anticipated construction cost impact from the code change if adopted in the FBCEC. This usually results in a decrease in construction cost, an increase in construction cost, or nothing. "None" means the code change has no or negligible impact on construction cost.

**Table A: Commercial Code Change Summary for 8th Edition (2023) Florida Energy Code vs. 2024 IECC**

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| **Chapter C4: Commercial Energy Efficiency** | | | | | |
| C402.1 General | CEPI-29-21, CEPI-28-21, CECPI-4-21, CEPI-27-21, CEPI-32-21, CEPI-31-21, CED1-92-22, CED1-94-22 | Revises the section for clarification and adds new requirements.<br><br>Revises item #1. Edits requirements for clarity and adds new thermal envelope requirements per section C402.1.2.1.8 when mechanical equipment envelope penetration area exceeds 1%.<br><br>Adds new item #2. Exterior wall solar reflectance and thermal *emittance* must comply with Section C402.3.<br><br>*Edits item #3 and adds new requirements. Fenestration* in the *building's thermal envelope* assemblies must comply with Section C402.5. *Building* and *building thermal envelope* must comply with Item 2 of Section C401.2.1, C401.2.2, or C402.1.4 if the vertical fenestration area or skylight exceeds Section C402.5 requirements.<br><br>Edits item #4 or #5 for clarity (duplicate items).<br><br>#4/#5. *Air leakage* of the building's thermal envelope must comply with Section C402.6.<br><br>Created new bullet items #6 and #7 from the existing code language. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| | | #6. *Thermal bridges* in *above-grade walls* must comply with Section C402.7.<br><br>#7. *Walk-in coolers*, *walk-in freezers*, *refrigerated warehouse coolers,* and *refrigerated warehouse freezers* must comply with Section C403.12.<br><br>Some of the changes may increase the code stringency but are cost-effective. | | | |
| C402.1.2.1.8 Mechanical equipment penetrations | CEPI-29-21, CED1-106-22, CED1-108-22 | This section adds a new subsection, C402.1.2.1.8. The changes require using an approved u-factor for the equipment or a default u-factor of 0.5 for the envelope impacted.<br><br>The code changes code implementation clarity and improves compliance. No impact on the construction cost. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C402.6.2 Air leakage compliance | CECPI-3-21,CEPI-58-21,CEPI-32-21,CEPI-61-21,CED1-131-22,CED1-132-22,CE2D-9-23, CEPI-71-21 | Renumbers and renames the title of Section C402.5.1.2, revises the testing requirements, re-arranges the provisions, and modifies the exceptions.<br><br>Reduces the measured air leakage threshold to 0.35 cfm/ft$^2$ from 0.40 cfm/ft$^2$ due to advances in air leakage control technology. Also, the measured air leakage upper limit was reduced to 0.45 cfm/ft$^2$ from 0.60 cfm/ft$^2$ for the exception. Exempts buildings larger than 25,000 ft$^2$ floor area from the testing requirement in climate zones 0 through 4.<br><br>Allows alternative testing method and maximum air-leakage rate for dwelling and sleeping units per Section C402.6.2.2.<br><br>It increases the code stringency, but it is a cost-effective change. This change makes the 2024 IECC equivalent to the ASHRAE 90.1-2022 requirement. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent code section is C402.5.1.2. | Decrease | Increase |
| C402.6.2.1 Whole building test method and reporting | CECPI-3-21, CE2D-9-23 | Section C402.5.3's title has been renumbered and renamed, and the provision has been rearranged. Part of the requirements has been moved, and referenced sections have been updated.<br><br>The modified exception permits air leakage testing of the entire building's thermal envelope for buildings with less than 10,000 ft$^2$ of floor area and a | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent code section is C402.5.1.2.3. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| | | portion of the building's thermal envelope for buildings with greater than 50,000 $ft^2$ of floor area. | | | |
| C402.6.2.2 Dwelling and sleeping unit enclosure method and reporting | CECPI-3-21, CE2D-9-23 | Renumbers and renames Section C402.5.2 and revises the provision to clarify the testing method and requirements. No change in the stringency. | The 2023 FBCEC doesn't have an equivalent section. Consider adding the subsection. | None | None |
| **Section C403 Building Mechanical Systems** | | | | | |
| C403.1 General | CEPI-76-21, CED1-198-22 | Revises the section to clarify the compliance requirements of mechanical systems and data center systems. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C403.1.2 Data centers | CEPI-75-21 | Revises that data centers must comply with Sections 6 and 8 of ASHRAE 90.4. | The 2023 FBCEC doesn't have an equivalent section. | None | None |
| Table C403.1.2(1) Maximum Design Mechanical Load Component (Design MLC) | | Deletes Table C403.1.2(1). Now the section directly references ASHRAE 90.4. | The 2023 FBCEC doesn't have an equivalent section. | None | None |
| Table C403.3.2(1) Electrically Operated Unitary Air Conditioners and Condensing Units-Minimum Efficiency Requirements | CED1-156-22, CE2D-13-23, CE2D-16-23, CE2D-18-23, | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. Removes minimum efficiency values of before 1/1/2023. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(1). | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C403.3.2(2) Electrically Operated Air-Cooled Unitary Heat Pumps—Minimum Efficiency Requirements | CED1-157-22, , CE2D-17-23, CE2D-19-23, CECD1-12-22 | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. Removes minimum efficiency values of before 1/1/2023. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(2). | None | None |
| Table C403.3.2(3) Liquid-Chilling Packages—Minimum Efficiency Requirements | | Deletes footnote f, which references ASHRAE 90.1. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(7). | None | None |
| Table C403.3.2(4) Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps-Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(3). Also, check federal minimum requirements. | None | None |
| Table C403.2.3(5) Warm Air Furnaces and Combination Warm Air Furnaces/Air-Conditioning Units, | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. Removes minimum efficiency values of before 1/1/2023. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent table is C403.2.3(4). Also, check federal minimum requirements. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Warm Air Duct Furnaces and Unit Heaters, Minimum Efficiency Requirements | | | | | |
| Table C403.3.2(6) Gas- and Oil-Fired Boilers—Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | Partly Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent table is C403.2.3(5). Also, check federal minimum requirements. | None | None |
| Table C403.3.2(7) Performance Requirements for Heat Rejection Equipment-Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(8). Also, check federal minimum requirements. | None | None |
| Table C403.3.2(8) Electrically Operated Variable Refrigerant Flow Multi-Split Air Conditioners-Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(11). Also, check federal minimum requirements. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C403.2.3(9) Electrically Operated Variable Refrigerant-Flow and Applied Heat Pumps-Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent table is C403.2.3(12). Change efficiency metrics to SEER2 and HSPF2. Also, check federal minimum requirements. | None | None |
| Table C403.3.2(10) Floor-Mounted Air Conditioners and Condensing Units Serving Computer Rooms-Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(9). Also, check federal minimum requirements. | | |
| Table C403.2.3(11) Vapor-Compression-Based Indoor Pool Dehumidifiers-Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(13). Also, check federal minimum requirements. | None | None |
| Table C403.3.2(12) Electrically Operated DX-DOAS Units, Single-Package, and Remote Condenser, without Energy Recovery—Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent table is C403.2.3(14). Change efficiency metrics to ISMRE2 and ISCOP2. Also, check federal minimum requirements. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C403.3.2(13) Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, with Energy Recovery—Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent table is C403.2.3(15). Change efficiency metrics to ISMRE2 and ISCOP2. Also, check federal minimum requirements. | None | None |
| Table C403.3.2(14) Electrically Operated Water-Source Heat Pumps—Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(16). Also, check federal minimum requirements. | None | None |
| Table C403.3.2(15) Heat-Pump and Heat Recovery Chiller Packages—Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | The 2023 FBCEC doesn't have an equivalent table. Also, check federal minimum requirements. | None | None |
| Table C403.3.2(16) Ceiling-Mounted Computer Room Air Conditioners—Minimum Efficiency Requirements | | Aligns the minimum efficiency requirements with the 2022 ASHRAE 90.1. | The 2023 FBCEC is already up-to-date. The 2023 FBCEC equivalent table is C403.2.3(17). Also, check federal minimum requirements. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.3.4 Boilers | CEPI-97-21, CED1-158-22 | Adds a new Section C403.3.4.<br><br>It requires combustion air positive shutoff control, and fan motors larger than 10 hp require a variable speed drive or control rather than a modulated fan airflow.<br><br>This change reduces the standby and part load heat losses by restricting airflow through the combustion chamber while maintaining the CO2 concentration in the flu gas. Although this change increases the stringency of the code, it is cost-effective per the Title 24 case study. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increases |
| C403.3.4.1 Boiler oxygen concentration controls | | Adds a new subsection C403.3.4.1. | Same as the change between the 2021 IECC and the 2024 IECC. | None | Increase |
| Table C403.3.4.1 Boiler Oxygen Concentrations | | Adds a new table C403.3.4.1. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C403.3.4.2 Boiler turndown | | Renumbers Section C403.3.4. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.4.2.5. | None | None |
| Table C403.3.4.2 Boiler Turndown | | Renumbers Table C403.3.4. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent Table is C403.4.2.5. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.4.1.2 Deadband | CEC2D-6-23 | Revises thermostat deadband requirements for zones with heating and cooling controls.<br><br>Requires: separately adjustable cooling and heating set-points, minimum dead band range of 1°F (0.56°C), and capable of supporting a dead band range of 5°F (3°C). Also, revise the exceptions.<br><br>This requirement already exists and is used in most current products. The change may slightly increase the stringency in some circumstances but is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.2.4.1.2. | Decrease | Increase |
| C403.4.1.3 Setpoint adjustment and display | | Adds new Section C403.4.1.3. This is mainly a clarification but may increase the stringency in some circumstances. | Same as the change between the 2021 IECC and the 2024 IECC. | None | Increase |
| C403.4.1.4 Setpoint overlap restriction | | Section C403.4.1.3 is renumbered and revises the requirement that mechanical or software means be used to prevent heating set-point and cooling set-point overlap. The stringency may increase in some situations. But this change is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.2.4.1.3. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.4.2.3 Optimum start and stop | CEPI-100-21, CED1-160-22 | Renames the section and makes editorial changes for clarification.<br><br>The change exempts Dwelling and Sleeping units from the optimum start and stop requirement. The exemption may decrease the stringency. | Consider changing the title and applying the editorial changes to clarify the provision. The 2023 FBCEC equivalent section is C403.2.4.2.3. | None | Decrease |
| C403.4.7 Heating and cooling system controls for operable openings to the outdoors | CEPI-65-21, CED1-160-22 | Renumbers Section C402.5.11, renames the "Operable openings interlocking" section, and revises the provision.<br><br>Reduces HVAC system disabling cut-out time to 5 minutes from 10 minutes. Adds six new exemptions.<br><br>This change does not impact the construction cost; it is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.5.11. | Decrease | None |
| C403.4.8 Humidification and dehumidification controls | CEPI-102-21 | Adds new Section C403.4.8 and three subsections. This change adds clarifications to humidity control requirements and allows lower relative humidity where mechanical cooling is used for temperature control. No impact on construction costs but may avoid simultaneous dehumidification and humidification process that reduces energy use. May decrease the stringency in some circumstances. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |
| C403.4.8.1 Dehumidification | | Adds new Section C403.4.8.1. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.4.8.2 Humidification | | Adds new Section C403.4.8.2. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C403.4.8.3 Control interlock | | Adds new Section C403.4.8.3. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C403.5 Economizers | CEPI-103-21 | This amendment removes the air-economizer exception for VRF systems installed with a dedicated outdoor air system(DOAS) but adds an air-economizer exemption for DX systems with multi-stage compressor capacity less than 54 kBtuh used with DOAS. It reduces the stringency by adding an exception for the most common DX system types. Therefore, this code change is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.3. | None | Decrease |
| C403.6.1 Variable air volume and multiple-zone systems | CEPI-107-21 | Revised the minimum airflow requirement for VAV systems.<br><br>For the DDC systems, the minimum flow can be sized using the ASHRAE 62.1 minimum ventilation requirement per the Simplified Ventilation Procedure. The modification provides design flexibility and, in some cases, may reduce energy costs. This change is cost-effective. | Partly same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.4.4. | Decrease | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.7.1 Demand control ventilation | CEPI-110-21, CED1-165-22, CE2D-23-2 | Revised demand control ventilation (DCV) requirements. Modified the minimum floor area threshold for the DCV requirement by climate zones. Spaces served with heat recovery exemptions are based on climate zone and floor area; the exception now applies to small floor areas only and is, hence, more restrictive. Increase the DCV stringency for climate zones 1A and 2A.<br><br>It also adds one new exception: ventilation system design professional engineers prevent the maximum limit of contaminant concentration from being higher than that obtainable by the required outdoor ventilation rate and maintain a ventilation threshold of 15% or higher.<br><br>FSEC conducted a cost-effectiveness study in selected prototype buildings and determined an average SIR of 3.47. Hence, this code modification is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.2.6.1. | Decrease | Increase |
| C403.7.2 Parking garage ventilation controls | CECPI-6-21, CED1-166-22 | Renamed the title of Section C403.7.2 and revised the provision to comply with Section C404.1 of IMC. The change also modified the exception based on the fan motor power instead of the ventilation flow rate.<br><br>This change is equivalent to the 2022 ASHRAE 90.1. This change slightly | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.2.6.2. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| | | increases construction costs but is cost-effective. | | | |
| C403.7.3 Ventilation air heating control | CEPI-112-21 | Adds new exception: "*Units that heat the airstream using only series energy recovery when representative building loads or outdoor air temperature indicates that the majority of zones require cooling in Climate Zones 0A, 1A, 2A, 3A, and 4A.*"<br><br>This change is cost-effective. | The 2023 FBCEC doesn't have an equivalent section. | None | Decrease |
| C403.7.8 Occupied standby controls | CEPI-108-21, CED1-168-22, CE2D-24-23 | Adds a new Section C403.7.8.<br><br>Occupied standby controls are required in the following space types: postsecondary classrooms, lecture rooms, and training rooms; conference/meeting/multipurpose rooms; lounges/breakrooms; enclosed offices; open-plan office areas; and Corridors.<br><br>The change incurs minimal or no construction cost increase while reducing lighting and fan power consumption. It is cost-effective and already included in the 2022 ASHRAE 90.1 code.<br><br>FSEC conducted a cost-effectiveness study in selected prototype buildings and determined an average SIR of 1.70. Hence, this code modification is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.7.8.1 Occupied-standby zone controls | | Adds new subsection C403.7.8.1. | Same as the change between the 2021 IECC and the 2024 IECC. | | |
| C403.7.8.1.1 Multiple-zone system controls | | Adds new subsection C403.7.8.1.1. | Same as the change between the 2021 IECC and the 2024 IECC. | | |
| C403.7.9 Dwelling unit ventilation system | CEPI-120-21 | Adds a new Section C403.7.9.<br><br>This change prohibits the use of an integrated central fan system design (heating and cooling) for outdoor air delivery. A separate fan must be used to deliver ventilation air.<br><br>Operating fan energy savings offset the increased construction costs. Therefore, this change is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C403.8.5 Low-capacity ventilation fans | CEPI-121-21 | Revises Section C403.8.5 for clarity, adds three new exceptions that preempt the federal regulations, and aligns the section with ASHRAE 90.1 and Energy Star requirements. There is no change in stringency. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.2.12.7. | None | None |
| Table C403.8.5 Low-Capacity Ventilation Fan Efficacy | | Updates Table C403.8.5 by adding test procedure by system type. Adds new system type category and edits the footnote. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent table is C403.2.12.7. | | |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.8.6.2 Intermittent exhaust control for bathrooms and toilet rooms | CEPI-123-21 | Adds new Section C403.8.6.2.<br><br>This change increases construction costs but reduces operating energy costs by reducing the fan runtime and avoiding increased outside air infiltration. Therefore, this change is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C403.9 Large-diameter ceiling fans | CEPI-124-21 | Revised Section C403.9.<br><br>It adds a minimum efficiency requirement based on the current market technology. The change has no impact on the construction costs. | The 2023 FBCEC is already up-to-date, and the equivalent section is C403.2.12.6. | None | None |
| Table C403.9 Ceiling Fan Efficiency Requirements | | Adds new Table C403.9. | The 2023 FBCEC is already up-to-date, and the equivalent table is C403.2.12.6. | None | None |
| C403.9.1 Ceiling Fan Energy Index (CFEI) | | Adds new subsection C403.9.1. | The 2023 FBCEC is already up-to-date, and the equivalent table is C403.2.12.6.1. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.10 Buildings with high-capacity space-heating gas boiler systems | CEPI-77-21 | Adds new Section C403.10. The changes require new construction condensing boiler to reach 90.0% efficiency levels. The changes increase the code stringency but is cost-effective.<br><br>FSEC conducted a cost-effectiveness study in selected prototype buildings and determined an average SIR of 1.180. Hence, this code modification is cost-effective. Primarily in building occupancy group that operate for 24 hours such as hotels and hospitals. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C403.10.1 Boiler efficiency | | Adds new subsection C403.10.1. | Same as the change between the 2021 IECC and the 2024 IECC. | | |
| C403.10.2 Hot water distribution system design | | Adds new subsection C403.10.2. | Same as the change between the 2021 IECC and the 2024 IECC. | | |
| C403.11 Heat rejection equipment | ? | Renumbers Section C403.10. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.4.3. | None | None |
| C403.11.6 Heat recovery for space conditioning in health care facilities | CECD1-13-22 | Renumbers Section C403.10.6, revises the provision to clarify the heat recovery implementation, and updates exception item #1. This change neither impacts the stringency nor impacts the construction cost. | The 2023 FBCEC doesn't have an equivalent section. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.14.2 Snow- and ice-melt system controls | | Renumbers Section C403.13.2. | No need to renumber the section. The 2023 FBCEC equivalent Section is C403.2.4.5. | None | None |
| C403.14.3 Roof and gutter deicing controls | | Adds new Section C403.13.3. | Same as the change between the 2021 IECC and the 2024 IECC. | None | Increase |
| C403.14.4 Freeze protection system controls | | Renumbers Section C403.13.3. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent section is C403.2.4.6. | None | None |
| C403.15 Dehumidification in spaces for plant growth and maintenance | CEPI-84-21 | Adds new Section C403.15.<br><br>This measure requires the installation of efficient dehumidification technology that may increase the initial equipment cost but save operational energy and maintenance costs; it is a cost-effective code requirement. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C403.16 Service water pressure-booster systems | CEPI-85-21 | Adds new Section C403.16.<br><br>Variable speed pressure booster systems can realize 20%—50% energy savings by using onboard pressure sensors and software for control logic instead of costly pressure-reducing devices and avoiding costly field mounted remote pressure sensors. Also, turns off the booster pump when there is no water flow. This code change uses current technology and has little or no impact on construction costs, making it cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |
| C403.17 Clean water pumps | CEPI-83-21 | Adds new Section C403.17.<br><br>This change specifies federal minimum efficiency requirements for clean water pumps and increases the stringency. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| **SECTION C404 SERVICE WATER HEATING** | | | | | |
| Table C404.2 Minimum Performance of Water-Heating Equipment | CEPI-127-21, CECD1-19-22, CE2D-26-23 | Updated the minimum efficiency requirements. Now, the efficiency levels vary by water draw patterns. The update is based on the federal minimum requirements. | The 2023 FBCEC efficiency values are already up-to-date. Update the footnotes and test conditions for heat pump water heaters as needed. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C404.4 Service water heating system piping insulation | CEPI-130-21 | This section renames the Section title, revises the code language for clarity, and adds an equation for insulation thickness update for alternate equivalent insulation material. It also revises the existing exceptions for tubular insulation and adds a new exception for piping not heated with fossil fuel or electricity. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C404.4.1 Installation requirements | | Adds a new Section C404.4.1. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| Table C404.4.1 Minimum Piping Insulation Thickness for Service Water Heating Systems | | Adds a new Table C404.4.1 instead of referencing from a different section. The insulation efficiency levels did not change. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C404.6.1 Circulation systems | CEPI-131-21 | The code is revised to require circulation pumps with thermostatic flow balancing valves and ECM motors. This increases construction costs but saves operating energy costs. The code change increases the stringency but is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| **SECTION C405 ELECTRICAL POWER AND LIGHTING SYSTEMS** | | | | | |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.2 Lighting controls | CEPI-150-21, CEPI-147-21, CEPI-148-21, CEPI-152-21, CEPI-187-21, CECD1-21-22, CECD1-23-22, CED1-65-22 | Revises the section such that interior parking area lighting requirement to comply with Section C405.2.9 and all other interior lighting system to comply with Sections C405.2.1 through C405.2.8.<br><br>Revises the existing exceptions for security and emergency areas and adds two new ones related to emergency exit access and fire alarm lighting systems. No change to code stringency. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C405.2.1 Occupant sensor controls | CECD1-3-22, CE2D-39-23 | This amendment adds four new space types to an existing space list requiring occupancy sensor lighting controls: a computer room, a data center, a medical supply room in a health care facility, a Laundry/washer area, and a telemedicine room. Expanding the occupancy sensor requirements to these new space types may increase the construction cost, but it is a cost-effective change. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C405.2.2 Time-switch controls | CEPI-152-21 | This change deletes three exceptions and modifies an existing exception in Section C405.2 as a substitute. There is no change in the code stringency. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.2.2.1 Time-switch control function | CECD1-22-22 | Replace the text "*Automatically*" with "*Programmed to automatically*" for clarity.<br><br>It adds a new requirement: "For spaces where schedules are not available, time switch controls are programmed to a schedule that turns off lights not less than 12 hours per day." This improves compliance enforcement when the schedule is unavailable but has no impact on construction costs. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |
| C405.2.3 Dimming controls | CEPI-154-21, CEPI-156-21 | This change renames the Section title, revises the section code provision, lists space types where dimming controls are required for general lighting, and removes the existing exceptions but adds a new exception for special application lighting. Current LED technologies, by design, have dimming control features. This change may slightly increase construction costs but saves lighting energy use, making it cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C405.2.3.1 Dimming control function | CEPI-156-21, CECD1-4-22 | Renames the Section title, revises the section code provision, and reduces the dimming limit to 10% of full power output from 20% for dimming controls and 30% for switchable controls. Adds two new exceptions from manual dimming control requirements for spaces with high-end trim lighting controls. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.2.4 Daylight-responsive controls | CEPI-161-21, CEPI-164-21 | Reduces the interior lights connected to the load threshold for daylighting responsive controls. Primary sidelit area and toplit areas lighting connected load were reduced to 75W from 150W, and combined primary and secondary sidelit areas were reduced from 300 W to 150 W.<br><br>It also revises exception item #3 and deletes equations 4-9 to simplify compliance.<br><br>This change has no impact on construction costs, hence, it is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |
| C405.2.4.2 Sidelit daylight zone | CEPI-167-21, CEPI-166-21 | Replace "*sidelit daylight zone*" with "*primary sidelit daylight zone*" in requirements #1 and #2 for code clarity.<br><br>Adds a clarifying text "*Where the fenestration is located in a wall*" for item #3. Removes the secondary sidelit daylighting zone calculation requirement. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C405.2.5 Specific application controls | CEPI-168-21, CEPI-169-21, CEPI-135-21, CECD1-1-22, CED1-27-22 | This section clarifies the provision, removes sleeping and dwelling unit lighting requirements, and adds a new requirement: " Lighting *integrated into range hoods and exhaust fans must be controlled independently of fans*."<br><br>This change has no impact on construction costs, hence, it is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.2.7.3 Lighting setback | CEPI-172-21, CEPI-173-21, CECD1-23-22 | Edit the code language for clarity and reduce the parking lot luminaire's total wattage threshold to 40 W from 78 W. This change may increase the stringency but is cost-effective.<br><br>The current LED technology has little or no construction cost change while reducing lighting energy use. Therefore, this code modification is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C405.2.8.1 Demand responsive lighting controls function | CE2D-45-23, CECD1-5-22 | It adds a new Section C405.2.8.1:<br><br>This new section simplifies the code by limiting the demand-responsive lighting control requirements to the B, E, M, and S building occupancy groups. It also adds an exception for storage rooms and warehouse spaces from dimming control; instead, it uses 25% or more switch-off control for general lighting, decreasing the code stringency. Therefore, this change is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | None | Decrease |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.2.10 Sleeping unit and dwelling unit lighting and switched receptacle controls | CED1-27-22 | This section adds a new Section C405.2.10 requiring sleeping and dwelling units to be provided with lighting controls and switched receptacles instead of occupancy sensor-based lighting and receptacle controls. This change simplifies the compliance requirements for dwelling and sleeping units, decreasing the stringency.<br><br>This change is a cost-effective alternative to occupancy sensor-based lighting and receptacle control. | Same as the change between the 2021 IECC and the 2024 IECC. | None | Decrease |
| C405.2.10.1 Sleeping units and dwelling units in hotels, motels and vacation timeshare properties | CE2D-40-23, CED1-27-22 | Adds new subsection C405.2.10.1. Requires a switched receptacle and occupant sensor lighting controls.<br><br>Automatic shutoff is not required where the captive key override controls all lighting and switched receptacles in units with five or fewer permanently installed lights and switched receptacles.<br><br>This change is a cost-effective alternative to occupancy sensor-based lighting and receptacle control. | Same as the change between the 2021 IECC and the 2024 IECC. | | |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.2.10.2 Sleeping units in congregate living facilities | CE2D-40-23, CE2D-41-23, CED1-27-22 | Adds new subsection C405.2.10.2.<br><br>Requires bathroom lighting to be controlled by an occupant sensor that can turn off lighting automatically within 20 minutes of not being occupied and manual lighting control at the entrance of each unit that can turn off lighting and switch receptacles in the unit, except for lighting in bathrooms and kitchens.<br><br>This change is a cost-effective alternative to occupancy sensor-based lighting and receptacle control. | Same as the change between the 2021 IECC and the 2024 IECC. | None | Decrease |
| C405.3.2.1 Building Area Method | CEPI-135-21, CECD1-21-22 | Adds a clarifying statement that sleeping and dwelling units are excluded from lighting power allowance calculations by applying a new Section C405.3.3, and their floor area is not included in the calculation. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C405.3.2.2 Space-by-Space Method | CEPI-135-21, CEPI-181-21, CECD1-21-22 | A clarifying statement was added that sleeping and dwelling units are excluded from lighting power allowance calculations by applying a new Section C405.3.3, and their area is not included in the calculation. Also, the total connected lighting power maximum allowance for unfinished spaces was reduced to 0.10 $W/ft^2$ from 0.20 $W/ft^2$. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C405.3.2(1) Interior Lighting Power Allowances: Building Area Method | CECPI-7-21, CEPI-135-21, CEPI-254-21 | Updates the LPD values in Table C405.3.2(1) based on improved lighting technologies and other requirements. The LPD values were mostly reduced. The measure is based on improved technology with little to no impact on the construction cost.<br><br>FSEC conducted a cost-effectiveness study in selected prototype buildings and determined an average SIR value of 2.10. Hence, this code change is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Very little or no cost impact |
| Table C405.3.2(2) Interior Lighting Power Allowances: Space-by-Space Method | CED1-9-22, CED1-75-22, CECPI-7-21, CEPI-135-21 | Updates the LPD values in Table C405.3.2(2) based on improved lighting technologies and other requirements. The LPD values were mostly reduced. The measure is based on improved technology with little to no impact on the construction cost.<br><br>FSEC conducted a cost-effectiveness study in selected prototype buildings and determined an average SIR value of 3.86. Hence, this code change is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Very little or no cost impact |
| C405.3.3 Lighting power for sleeping units and dwelling units | CE2D-48-23, CECD1-21-22, CECD1-1-22 | Adds a new Section C405.3.3 by moving from a deleted Section C405.1.1. No change in stringency. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.4 Horticultural lighting | CEPI-185-21 | It renames the section title, edits the code language, and increases the photon efficiency. This change may slightly increase construction costs due to the higher efficacy requirement for horticultural lighting, but it saves more energy due to the improved efficiency. It increases the stringency, but this change is expected to be cost-effective due to advances in lighting control technologies. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent Section is C405.9. | Decrease | Increase |
| Table C405.5.2(2) Lighting Power Allowances for Building Exteriors | CECD1-23-22, CEPI-189-21,CEPI-254-21 | Table C405.5.2 (2) changes the exterior lighting power allowance values. It reduces the allowances based on advances in lighting technology and aligns with ASHRAE 90.1 requirements.<br><br>It increases the stringency but may involve construction costs since the LPD has not changed in 2021.<br><br>FSEC conducted a cost-effectiveness study in selected prototype buildings and determined an average SIR value of 2.02, which means this code change is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent Table is C405.4.2(2). | Decrease | Increases |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C405.5.2(3) Individual Lighting Power Allowances for Building Exteriors | CEPI-189-21, CEPI-254-21, CECD1-23-22 | Updates the individual exterior lighting power allowance values in Table C405.5.2(3). Reduces the individual lighting power allowances based on advances in lighting technology and aligns with ASHRAE 90.1 requirements. It increases the stringency but has little or no impact on the construction costs. This change is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. The 2023 FBCEC equivalent Table is C405.4.2(3). | Decrease | None |
| C405.9 Data centers and computer rooms | CEPI-134-21, CED1-78-22 | It adds a new Section C405.9 by moving the provision from Section C405.1 and aligns the requirement with the ASHRAE Standard 90.4 for computer rooms. This change may increase the stringency of computer room requirements and the construction cost. | The 2023 FBCEC does not have an equivalent code. This aligns the efficiency requirements of computer rooms with data centers as defined in ASHRAE Standard 90.4, increasing the stringency. | Decrease | Increase |
| C405.9.1 Data centers | CED1-78-22 | It adds a new subsection, C405.9.1, for data centers by moving data center requirements from Section C405.1. This has no impact on the stringency. | The 2023 FBCEC does not have an equivalent code. It adds ASHRAE Standard 90.4 requirements for data centers. This change increases the stringency but is cost-effective. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.9.2 Computer rooms | CED1-78-22 | It adds a new Section C405.9.2 for computer rooms that aligns with ASHRAE Standard 90.4. This change increases the stringency of computer rooms code provision; hence, the construction cost of computer rooms. | The 2023 FBCEC does not have equivalent code. Adds ASHRAE Standard 90.4 requirements for computer rooms. This change increases the stringency but is a cost-effective. | Decrease | Increase |
| C405.12 Automatic receptacle control | | Renumbers Section C405.11. | The 2023 FBCEC doesn't have this section.<br><br>Worth considering adding to 9th Edition (2026) FBC-EC. | None | None |
| C405.12.1 Automatic receptacle control function | | Renumbers subsection C405.11.1. | The 2023 FBCEC doesn't have this section.<br><br>Worth considering adding to 9th Edition (2026) FBC-EC. | None | None |
| C405.13 Energy monitoring | CEPI-138-21, CEPI-203-21, CED1-31-22, CED1-30-22, CE2D-29-23, CE2D-33-23 | Renumbers Section C405.12. Reduces the building floor area threshold for energy monitoring from 25,000 $ft^2$ to 10,000 $ft^2$, makes editorial changes, updates referenced code section, and adds a new exception for dwelling units. Increases the stringency by reducing the floor area threshold but exempts all residential units, which may reduce the stringency. Therefore, the stringency may increase depending on the building occupancy group, but it is a cost-effective change. | The 2023 FBCEC doesn't have this section. Consider adding it as a new section, including its subsections, but there is a code overlap. Previous FSEC investigations have demonstrated that this code modification is cost-effective.<br><br>Worth considering adding to 9th Edition (2026) FBC-EC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.13.1 Electrical energy metering | CE2D-33-23 | Renumbers subsection C405.12.1. | The 2023 FBCEC doesn't have this section. | None | None |
| C405.13.2 End-use electric metering categories | CEPI-203-21, CE2D-33-23, CED1-30-22 | Renumbers subsection C405.12.2 and replaces the text "*measured load*" with "*design load*." | The 2023 FBCEC doesn't have this section. | None | None |
| Table C405.13.2 Electrical Energy Use Categories | CE2D-33-23, CED1-30-22, CED1-36-22, CEAPP-01-24 | Table C405.12.2 has been renumbered, the title has been renamed, and the text has been edited for clarity. A new energy end use category has been added: "Electric hot water heating for uses other than space conditioning." | The 2023 FBCEC doesn't have this section. | None | None |
| C405.13.3 Electrical meters | CEPI-203-21, CE2D-33-23, CED1-30-22 | Renumbers Section C405.12.3, renames the title, and edits the code language for clarity. | The 2023 FBCEC doesn't have this section. | None | None |
| C405.13.4 Electrical energy data acquisition system | CEPI-203-21, CED1-30-22 | Renumbers Section C405.12.4, renames the title, and edits the code language for clarity. | The 2023 FBCEC doesn't have this section. | None | None |
| C405.13.5 Graphical energy report | CEPI-203-21, CED1-30-22, CE2D-10-23, CE2D-33-23 | Renumbers Section C405.12.5 and edits the code language for clarity. | The 2023 FBCEC doesn't have this section. | None | None |
| C405.13.6 Renewable energy | CEPI-203-21, CED1-30-22, CE2D-33-23 | Adds a new subsection C405.13.6. | This new subsection is not applicable without the "Energy Monitoring" Section. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.13.7 Nonelectrical energy submetering | CE2D-33-23 | Adds a new subsection C405.13.7. | This new subsection is not applicable without the "Energy Monitoring" Section. | None | None |
| C405.13.8 End-use nonelectrical submetering categories | | Adds a new subsection C405.13.8. | This new subsection is not applicable without the "Energy Monitoring" Section. | None | None |
| Table C405.13.8 Nonelectrical Energy Use Categories | | Adds a new Table C405.13.8. | This new table is not applicable without the "Energy Monitoring" Section. | None | None |
| C405.13.9 Nonelectrical submeters | | Adds a new subsection C405.13.9. | This new subsection is not applicable without the "*Energy Monitoring*" Section. | None | None |
| C405.13.10 Nonelectrical energy data acquisition system | | Adds a new subsection C405.13.10. | This new subsection is not applicable without the "Energy Monitoring" Section. | None | None |
| C405.13.11 Graphical energy report | | Adds a new subsection C405.13.11. | This new subsection is not applicable without the "Energy Monitoring" Section. | None | None |
| C405.14 Reserved. | CECPI-1-21, CED1-39-22 | Adds a reserved Section C405.14. | Not relevant. The intent is not clear. | None | None |
| C405.15 Renewable energy systems | CECPI-2-21 | Adds a new Section C405.15.<br><br>Adds on-site renewables energy requirement to reduce consumer energy cost and societal protection. | Same as the change between the 2021 IECC and the 2024 IECC. The energy and construction cost impacts are reflected at the individual subsections. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.15.1 On-site renewable energy systems. | CECPI-2-21, CED1-50-22 | Adds a new subsection C405.15.1. Requires that buildings must be provided with on-site renewable electricity generation systems with a direct current (DC) nameplate power rating of not less than 0.75 W/ft$^2$ (8.1 W/m$^2$) multiplied by the sum of the gross conditioned floor area of all floors, but not to exceed the combined gross conditioned floor area of the three largest floors. Has four exceptions. This change increases the code stringency but is a cost-effective change.<br><br>FSEC conducted a cost-effectiveness study and determined an SIR value of 1.26. Therefore, this change is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C405.15.2 Off-site renewable energy | | Adds a new subsection C405.15.2. Must procure off-site renewable electrical energy per Section C405.15.2.1 and C405.15.2.2 if it qualifies for one of the exceptions in Section C405.15.1.<br><br>This provides a design alternative without an on-site renewable energy generator. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| Table C405.15.2 Annual Off-Site Renewable Energy Requirements | CECPI-2-21, CED1-50-22 | Adds a new Table C405.15.2. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C405.15.2.1 Off-site procurement | CECPI-2-21, CED1-50-22, CED1-55-22, CED1-56-22 | Adds a new subsection C405.15.2.1. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C405.15.2.2 Off-site contract | CECPI-2-21, CED1-50-22 | Adds a new subsection C405.15.2.2. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C405.15.3 Renewable energy certificate (REC) documentation | | Adds a new subsection C405.15.3. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C405.15.4 Renewable energy certificate purchase | | Adds a new subsection C405.15.4. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C405.16 Inverters | CEPI-142-21 | Adds a new Section C405.16.<br><br>This change slightly increases stringency and, hence, the construction cost, but it is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| **SECTION C406 ADDITIONAL EFFICIENCY, RENEWABLE AND LOAD MANAGEMENT REQUIREMENTS** | | | | | |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406 | CEPI-193-21 | Deletes the existing Section C406 and replaces it with an expanded scope of Section C406 measures to choose from, renames the title, adds separate new measures for renewable energy and load management requirements, and increases the number of energy efficiency measures to 32 from 11. The new measures are cost-effective and provide design flexibility. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.1 Compliance | CEPI-193-21, CED1-185-22, CED1-187-22 | This amendment renames the title and rearranges the subsection for on-site renewable energy generation and load management requirements. It moves some of the section content to a new subsection, C406.1.1. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.1.1 Additional energy efficiency credit requirements | CEPI-193-21, CED1-187-22, CED1-190-22, CE2D-51-23 | It adds a new subsection, C406.1.1, specifying energy credit requirements by building occupancy group and climate zones. The building occupancy group has been increased, and efficiency measures have been expanded, which provides design flexibility by better matching the measures with the building occupancy group.<br><br>Most new measures may increase the stringency but are expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. There will be an overlap since the 2023 FBCEC lags on this section.<br><br>The impact of energy and construction costs is reflected in the individual subsection. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C406.1.1(1) Energy Credit Requirements by Building Occupancy Group | CEPI-193-21, CED1-190-22 | It adds a new Table, C406.1.1(1), specifying the energy credit requirements by building occupancy group and climate zones. Increased the number of measures to 32 from 11 and expanded the building occupancy group that provides design flexibility. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| Table C406.1.1(2) Limit to Energy Efficiency Credit Carryover from Renewable and Load Management Credits | CEPI-193-21, CED1-190-22, CE2D-51-23 | It adds a new Table, C406.1.1(2), that specifies limits to energy efficiency credit carryover from renewable and load management by building occupancy group and climate zones. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.1.1.1 Reserved | CEPI-193-21, CECD1-18-22, CE2D-51-23, CE2D-57-23, As further modified by ICC Board Action | Reserves Section C406.1.1.1. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.1.1.2 Building core/shell and build-out construction | CEPI-193-21, CECD1-18-22 | This amendment adds a new Section C406.1.1.2, an additional efficiency requirement for core/shell buildings. Although it may increase the stringency of core/shell building compliance types, it is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.1.2 Additional renewable and load management credit requirements | CEPI-193-21, CED1-192-22, CE2D-58-23 | It adds a new Section C406.1.2. It increases the stringency for some of the building types, but it provides design alternatives. Construction costs impacts are provided for an individual measure. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| Table C406.1.2 Renewable and Load Management Credit Requirements by Building Occupancy Group | CEPI-193-21, CED1-185-22, CED1-192-22 | Adds new Table C406.1.2. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.2 Additional energy efficiency credits achieved | CEPI-193-21, CED1-185-22, CED1-187-22, CE2D-61-23 | Renames Section C406.2 title and describes achievable energy efficiency credits for each measure by building occupancy group and climate zones. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| Table C406.2(1) Base Energy Credits for Group R-2, R-4 and I-1 Occupancies | CEPI-193-21, CECD1-6-22, CED1-185-22, | Table C406.1(1) has been renamed, renumbered and rearranged. The measures have been expanded to 32 from 11, and the achievable energy credits have been updated. | The 2023 FBCEC didn't have this table, so it entails more changes than the changes between the 2021 IECC and the 2024 IECC. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C406.2(2) Base Energy Credits for Group I-2 Occupancies | CED1-194-22 | Table C406.1(2) has been renamed, renumbered and rearranged. The measures have been expanded to 32 from 11, and the achievable energy credits have been updated. | The 2023 FBCEC didn't have this table, so it entails more changes than the changes between the 2021 IECC and the 2024 IECC. | None | None |
| Table C406.2(3) Base Energy Credits for Group R-1 Occupancies | | Table C406.1(3) has been renamed, renumbered and rearranged. The measures have been expanded to 32 from 11, and the achievable energy credits have been updated. | The 2023 FBCEC didn't have this table, so it entails more changes than the changes between the 2021 IECC and the 2024 IECC. | None | None |
| Table C406.2(4) Base Energy Credits for Group B Occupancies | CEPI-193-21, CED1-185-22, CED1-194-22 | Table C406.1(4) has been renamed, renumbered and rearranged. The measures have been expanded to 32 from 11, and the achievable energy credits have been updated. | The 2023 FBCEC didn't have this table, so it entails more changes than the changes between the 2021 IECC and the 2024 IECC. | None | None |
| Table C406.2(5) Base Energy Credits for Group A-2 Occupancies | CEPI-193-21, CECD1-6-22, CED1-185-22, CED1-194-22 | Table C406.1(5) has been renamed, renumbered and rearranged. The measures have been expanded to 32 from 11, and the achievable energy credits have been updated. | The 2023 FBCEC didn't have this table, so it entails more changes than the changes between the 2021 IECC and the 2024 IECC. | None | None |
| Table C406.2(6) Base Energy Credits for Group M Occupancies | CEPI-193-21, CED1-185-22, CED1-194-22 | Adds a new base energy credits Table C406.2(6) for group M occupancies with 32 measures. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| Table C406.2(7) Base Energy Credits for Group E Occupancies | | Adds new based energy credits Table C406.2(7) for group E occupancies with 32 measures. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C406.2(8) Base Energy Credits for Group S-1 and S-2 Occupancies | | Adds a new base energy credits Table C406.2(8) for group S-1 and S-2 occupancies with 32 measures. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| Table C406.2(9) Base Energy Credits for Other Occupancies | CEPI-193-21, CECD1-6-22, CED1-185-22, CED1-194-22 | Adds a new base energy credits Table C406.2(9) for group S-1 and S-2 occupancies with 32 measures. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.2.1 More efficient building thermal envelope | CEPI-193-21, CED1-92-22 | It adds new Section C406.2.1 for achieving energy credits with the improved building envelope. It may increase the stringency. This section covers improved envelope measures E01 through E06. | Same as the change between the 2021 IECC and the 2024 IECC. The energy and impact are accounted for in the subsections. | None | None |
| C406.2.1.1 E01 Improved envelope performance ASHRAE 90.1 Appendix C | CEPI-193-21, CED1-92-22, CED1-110-22, CE2D-61-23 | It adds a new subsection, C406.2.1.1. The improved envelope performance requirement may increase the stringency. It requires using the ASHRAE 90.1 Appendix C method.<br><br>This change increases construction costs but is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC | Decrease | Increase |
| C406.2.1.2 E02 Component performance envelope reduction | CEPI-193-21 | Adds new subsection C406.2.1.2 based on the existing code C406.8. There is no change in stringency. | The 2023 FBCEC didn't have this requirement option. It will be a new measure for FBCEC but with an overlap. | Decrease | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.2.1.3 E03 Reduced air leakage | CEPI-193-21, CE2D-9-23 | Adds new subsection C406.2.1.3 based on the existing code C406.9. It increases the stringency by reducing the maximum allowed air leakage by at least 10%. It increases the construction costs but is expected to be cost-effective. | The 2023 FBCEC didn't have this requirement option. Thus, it will be a new measure for FBCEC but with an overlap. | Decrease | Increase |
| C406.2.1.4 E04 Added roof insulation | CEPI-193-21 | This change adds a new subsection, C406.2.1.4. Although it increases the code's stringency, it is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.2.1.5 E05 Added wall insulation | CEPI-193-21 | It adds a new subsection, C406.2.1.5. Although it increases the code's stringency, it is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.2.1.6 E06 Improve fenestration | CEPI-193-21, CED1-185-22, CED1-195-22 | It adds a new subsection, C406.2.1.6. Although it increases the code's stringency, it is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| Table C406.2.1.6 Vertical Fenestration Requirements for Energy Credit E06 | CEPI-193-21, CED1-194-22 | Adds new Table C406.2.1.6. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.2.2 More efficient HVAC equipment performance | CEPI-193-21, CED1-185-22 | Added new Section C406.2.2 for achieving credits with improved HVAC equipment. | Same as the change between the 2021 IECC and the 2024 IECC. The energy and impact are accounted for in the subsections. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.2.2.1 H01 HVAC Total System Performance Ratio (TSPR) | CEPI-193-21, CED1-198-22, CE2D-61-23 | Adds new subsection C406.2.2.1. It increases the stringency but is cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.2.2.2 H02 More efficient HVAC equipment heating performance | CEPI-193-21, CED1-185-22 | This amendment adds a new subsection, C406.2.2.2, by revising an existing measure. It increases the stringency, but it is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.2.2.3 H03 More efficient HVAC cooling equipment and fan performance | CEPI-193-21, CED1-185-22 | This change adds a new subsection, C406.2.2.3 by revising an existing measure. It increases the stringency but is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.2.2.4 H04 Residential HVAC control | CEPI-193-21 | It adds a new subsection, C406.2.2.4, which requires centralized HVAC setback control in multi-family buildings. Although it increases the stringency, it is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.2.2.5 H05 Dedicated outdoor air system | CEPI-193-21, CED1-173-22, CED1-185-22 | It adds a new subsection, C406.2.2.5, by modifying an existing measure. Although it increases the stringency, it is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC | Decrease | Increase |
| Table C406.2.2.5 DOAS Energy Recovery Adjustments | CEPI-193-21, CED1-185-22 | Adds new Table C406.2.2.5. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.2.3 Reduced energy use in service water heating | CEPI-193-21 | Adds new Section C406.2.3. Achieving energy credits by reducing water heating energy for SWH. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| C406.2.3.1 Service water heating system efficiency | CEPI-193-21 | Adds new subsection C406.2.3.1 based on existing requirements. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| C406.2.3.1.1 W01 Recovered or renewable water heating | CEPI-193-21, CED1-185-22 | Adds new subsection C406.2.3.1.1 based on the existing code C406.7.2. There is no change in stringency. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.2.3.1.2 W02 Heat pump water heater | CEPI-193-21, CED1-185-22 | Adds new subsection C406.2.3.1.2 by modifying an existing measure. Heat pump water heaters are cost-effective technologies, especially in hot climates. | The 2023 FBCEC didn't have this requirement option. It will be a new measure for FBCEC but it is expected to be cost-effective measure. | Decrease | Increase |
| C406.2.3.1.3 W03 Efficient fossil fuel water heater | CEPI-193-21, CED1-185-22 | Adds new subsection C406.2.3.1.3 based on the existing code C406.7.3. There is no change in stringency. | The 2023 FBCEC didn't have this requirement option. It is going to be a new measure for FBCEC. | Decrease | Increase |
| C406.2.3.1.4 Combination service water heating systems | CEPI-193-21 | Adds new subsection C406.2.3.1.4. It increases the stringency but is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.2.3.2 W04 Service hot water piping insulation increase | CEPI-193-21, CED1-185-22 | Adds new subsection C406.2.3.2. It increases the stringency but is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.2.3.3 Service water-heating distribution temperature maintenance | CEPI-193-21, CED1-185-22, CED1-174-22 | Adds new subsection C406.2.3.3. It increases the stringency but is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| | | 1. W05 Point of use water heaters. It increases the stringency but it is expected to be a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| | | 2. W06 Thermostatic balancing valves. It increases the stringency but it is expected to be a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| | | 3. W07 Heat trace system. It increases the stringency but is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.2.3.4 W08 Water-heating system submeters | CEPI-193-21 | Adds new subsection C406.2.3.4. It increases the stringency but could be a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC | Decrease | Increase |
| C406.2.3.5 W09 Service hot water flow reduction | | Adds new subsection C406.2.3.5. It increases the stringency but is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.2.3.6 W10 Shower drain heat recovery | | Adds new subsection C406.2.3.6. It increases the stringency but is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C406.2.3.5 Maximum Flow Rating for Residential Plumbing Fixtures with Heated Water | | Adds new Table C406.2.3.5. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.2.4 P01 Energy monitoring | CEPI-193-21 | Adds new Section C406.2.4 based on an existing measure. Achieving energy credits using an energy monitoring system. Energy monitoring is a cost-effective measure. In previous studies, FSEC has demonstrated its cost-effectiveness. | The 2023 FBCEC didn't have this requirement option. It will be a new measure that overlaps with the FBCEC. | Decrease | Increase |
| C406.2.5 Energy savings in lighting systems | CEPI-193-21, CED1-81-22 | Adds new Section C406.2.5. Achieving energy credits by enhancing lighting performance. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| C406.2.5.1 L01 Lighting system performance | CEPI-193-21 | Reserves for future use. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| C406.2.5.2 L02 High-end trim lighting controls | CEPI-193-21, CECD1-4-22 | This section adds new Section C406.2.5.2 by modifying an existing lighting control measure. It increases the stringency but could be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.2.5.3 L03 Increase occupancy sensor | CEPI-193-21 | Adds new Section C406.2.5.3. Expands occupancy sensor based lighting control to 13 space types that are not required by Section C405.2.1. It increases the stringency but could be a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC | Decrease | Increase |
| C406.2.5.3.1 Occupant sensor controls | CEPI-193-21, CECD1-3-22, CED1-185-22 | Adds new subsection C406.2.5.3.1. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| C406.2.5.3.2 Occupant sensor control function | CEPI-193-21, CECD1-3-22, CED1-185-22 | Adds new subsection C406.2.5.3.2. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| C406.2.5.3.3 Occupant sensor time delay and setpoint | CEPI-193-21, CECD1-3-22, CED1-185-22 | Adds new subsection C406.2.5.3.3. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| C406.2.5.4 L04 Increased daylight area | CEPI-193-21, CED1-185-22, CECD1-6-22 | Adds new subsection C406.2.5.4 based on existing measure. Increases the floor area controlled by daylight responsive control by about 5%. It may lightly increases the stringency but is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. This code change is an overlap for FBCEC. | Decrease | Increase |
| Table C406.2.5.4 Added Daylighting Parameters | CEPI-193-21, CECD1-6-22 | Adds new Table C406.2.5.4. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.2.5.5 L05 Residential light control | CEPI-193-21, CE2D-64-23, CECD1-16-22, CE2D-64-23 | Adds new subsection C406.2.5.5. This is a simpler lighting control strategy. It does impact the stringency since lighting control is required elsewhere in the code. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |
| C406.2.5.6 L06 Reduced lighting power | CEPI-193-21, CECD1-7-22 | Adds new subsection C406.2.5.6 by expanding and clarifying an existing measure. There is no change in stringency. | This requirement is not an option in the 2023 FBCEC, so it will be a new measure for FBCEC. Lighting power reduction is a cost-effective measure. | Decrease | Increase |
| C406.2.6 Efficient equipment credits | CEPI-193-21 | Adds new Section C406.2.6. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| C406.2.6.1 Q01 Efficient elevator equipment | CEPI-193-21, CED1-185-22 | Adds new subsection C406.2.6.1. The measure requires the installation of higher-efficiency elevator equipment. It increases the stringency but is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC | Decrease | Increase |
| C406.2.6.2 Q02 Efficient commercial kitchen equipment | CEPI-193-21 | Adds new subsection C406.2.6.2 based on an existing measure. There is no change in stringency. | This requirement is not an option in the 2023 FBCEC, so it will be a new measure for FBCEC. This change is expected to be a cost-effective measure. | Decrease | Increase |
| Table C406.2.6.2(1) Minimum Efficiency Requirements: Commercial Fryers | | Adds new Table C406.2.6.2(1) based on an existing Table C406.12(1). There is no change in stringency. | This requirement is not an option in the 2023 FBCEC, so it will be a new Table for FBCEC. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C406.2.6.2(2) Minimum Efficiency Requirements: Commercial Steam Cookers | | Adds new Table C406.2.6.2(2) based on an existing Table C406.12(2). There is no change in stringency. | This requirement is not an option in the 2023 FBCEC, so it will be a new Table for FBCEC. | None | None |
| Table C406.2.6.2(3) Minimum Efficiency Requirements: Commercial Dishwashers | | Adds new Table C406.2.6.2(3) based on an existing Table C406.12(3). There is no change in stringency. | This requirement is not an option in the 2023 FBCEC, so it will be a new Table for FBCEC. | None | None |
| Table C406.2.6.2(4) Minimum Efficiency Requirements: Commercial Ovens | | Adds new Table C406.2.6.2(4) based on an existing Table C406.12(4). There is no change in stringency. | This requirement is not an option in the 2023 FBCEC, so it will be a new Table for FBCEC. | None | None |
| C406.2.6.3 Q03 Efficient residential kitchen equipment | CEPI-193-21, CED1-175-22 | This subsection adds a new subsection, C406.2.6.3. It requires the installation of higher-efficiency or Energy Star refrigerators in apartment and hotel guestrooms. Although the stringency is slightly increased, it is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC | Decrease | Increase |
| C406.2.6.4 Q04 Fault detection and diagnostics system | CEPI-193-21 | Adds new subsection C406.2.6.4 based on an existing measure. There is no change in stringency. | This requirement is not an option in the 2023 FBCEC, so it will be a new measure for FBCEC. This change is expected to be a cost-effective measure. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.3 Renewable and load management credits achieved | CEPI-193-21, CED1-175-22 | It adds a new Section C406.3: Achieving energy credits for renewable and load management measures. This change may increase the stringency. See the individual measure. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| Table C406.3(1) Renewable and Load Management Credits for Group R-2, R-4 and I-1 Occupancies | CEPI-193-21 | Adds new Table C406.3(1). | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| Table C406.3(2) Renewable and Load Management Credits for Group I-2 Occupancies | | Adds new Table C406.3(2). | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| Table C406.3(3) Renewable and Load Management Credits for Group R-1 Occupancies | | Adds new Table C406.3(3). | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| Table C406.3(4) Renewable and Load Management Credits for Group B Occupancies | | Adds new Table C406.3(4). | Same as the change between the 2021 IECC and the 2024 IECC | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C406.3(5) Renewable and Load Management Credits for Group A-2 Occupancies | | Adds new Table C406.3(5). | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| Table C406.3(6) Renewable and Load Management Credits for Group N Occupancies | | Adds new Table C406.3(6). It slightly increase the stringency. | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| Table C406.3(7) Renewable and Load Management Credits for Group E Occupancies | | Adds new Table C406.3(7). | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| Table C406.3(8) Renewable and Load Management Credits for Group S-1 and S-2 Occupancies | | Adds new Table C406.3(8). | Same as the change between the 2021 IECC and the 2024 IECC | None | None |
| Table C406.3(9) Renewable and Load Management Credits for Other Occupancies | | Adds new Table C406.3(9). | Same as the change between the 2021 IECC and the 2024 IECC | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.3.1 R01 Renewable energy | CEPI-193-21 | This amendment adds new Section C406.3.1 by expanding an existing additional energy efficiency measure. It also increases the renewable energy generation capacity by at least 0.1 watts per gross square foot (1.08 $W/m^2$) of building area or secures off-site renewable energy. This change may increase the code stringency but provides a simpler compliance verification alternative. This change is expected to be a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.3.2 G01 Lighting load management | CEPI-193-21, CECD1-5-22 | This section adds a new Section, C406.3.2. Lighting dimming reduces lighting levels and power. The lighting dimming control requires integration with automated controls that interface with utility signals or local building demand monitoring software. It increases the stringency, but it is expected to be a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.3.3 G02 HVAC load management | CEPI-193-21, CED1-161-22 | It adds new Section C406.3.3. This requires thermostats to be reset during peak price periods or a gradual pre-cooling set-point adjustment control sequence, as well as integration with automated controls that interface with utility signals or local building demand monitoring software. It increases the stringency, but it is expected to be a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Table C406.3.3 Energy Credit Adjustment Based on Use of Ventilation Shift or Demand Response | CEPI-193-21, CED1-161-22 | Adds new Table C406.3.3 | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.3.4 G03 Automated shading load management | CEPI-193-21, CED1-141-22 | This amendment adds new Section C406.3.4. The measure requires an automated external exterior roller, movable blind, or movable shutter shading device to reduce solar gain through fenestration during peak price hours. Thus, it increases the stringency, but it is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.3.5 G04 Electric energy storage | CEPI-193-21 | This amendment adds a new Section C406.3.5. Batteries or other electric energy storage devices are required, as is integration with automated controls that interface with utility signals or local building demand monitoring software. The change increases the stringency, but it is expected to be cost-effective. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| C406.3.6 G05 Cooling energy storage | CEPI-193-21, CED1-185-22 | This adds a new Section C406.3.6. Ice or chilled water cooling energy storage is required, as is integration with automated controls that interface with utility signals or local building demand monitoring software. The change increases the stringency, but it is a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C406.3.7 G06 Service hot water energy storage | CEPI-193-21, CED1-176-22 | It adds a new Section C406.3.7. It requires integration with automated controls that interface with utility signals or local building demand monitoring software. Thus, it increases the stringency but it is expected to be a cost-effective measure. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | Increase |
| Table C406.3.7 Energy Credit Adjustment Based on Use of Heat Pump Water Heater or Demand Response | CEPI-193-21, CED1-176-22 | Adds new Table C406.3.7. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| C406.3.8 G07 Building thermal mass | CEPI-193-21, CED1-92-22, CED1-185-22 | This measure adds a new Section C406.3.8. It is primarily a change in operational strategies and the use of interior thermal mass. It has no impact on the stringency. | Same as the change between the 2021 IECC and the 2024 IECC. | Decrease | None |
| **SECTION C407 SIMULATED BUILDING PERFORMANCE** | | | | | |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C407.2 Mandatory requirements | CEPI-193-21, CEPI-207-21, CEPI-24-21 Part I, CED1-185-22 | Replace the text "*total*" with "*simulated*."<br><br>Revises the provision that the proposed building design's annual energy cost is compared to a percentage calculated based on a new equation 4-33 that accounts for energy credits instead of a fixed percentage of 80.0%.<br><br>It also Adds a new exception, which allows the use of source energy as a substitute for energy cost. | Same as the change between the 2021 IECC and the 2024 IECC if the latest additional efficiency credit section is adopted. The relevant Section is C401.2. | None | None |
| Table C407.2(1) Requirements for Simulated Building Performance | CEPI-193-21, CEPI-24-21 Part I, CED1-92-22 | Updated Table C407.2(1). | The 2023 FBCEC doesn't have this table. | None | None |
| Table C407.2(2) Source Energy Conversion Factors for Electricity | CEPI-207-21 | Adds new Table C407.2(2) for source energy conversion factors by fuel types. | Same as the change between the 2021 IECC and the 2024 IECC. | None | None |
| Table C407.4.1(1) Specifications for The Standard Reference and Proposed Designs | CECPI-2-21, CECPI-4-21, CEPI-211-21, CEPI-212, 21, CED1-197-22 | Updates Table C407.4(1).<br><br>Replaces the solar absorptance requirement with solar reflectance for roofs and above-grade walls. Updates the roof's emittance requirement.<br><br>It adds a thermal bridge requirement, but climate zones 0 through 3 are exempted.<br>Replace "Mechanical ventilation" with "Outdoor airflow" and revise the standard reference design for | Same as the change between the 2021 IECC and the 2024 IECC. However, this change is exempted in Florida climate zones. | Decrease | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| | | mechanical ventilation air requirements based on the system type. If the proposed building has natural ventilation, use the same for the standard reference design.<br><br>Adds "*Energy recovery*" as a new building component characteristic. If the proposed design specifies ventilation airflow, use the same as the proposed; otherwise, if the proposed design has mechanical ventilation, use the same but with the standard reference design airflow.<br><br>Adds "*Fan power*" as a new building component characteristic and requires modeling per Section C403.8.<br><br>Adds "*On-site renewable energy*" as a new building component characteristic and has requirements. | | | |
| **SECTION C408 MAINTENANCE INFORMATION AND SYSTEM COMMISSIONING** | | | | | |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C408.2 Mechanical systems and service water-heating systems commissioning and completion requirements | CEPI-215-21, CED1-177-22 | Revises exceptions items #1 and #2.<br><br>Exception #1 is now based upon a gross conditioned floor area of less than 10,000 $ft^2$ and a combined cooling, heating, and service water heating capacity of less than 960 kBtu/h instead of a capacity limit only.<br><br>Exception item #2 is now based on the HVAC system type and single-zone thermostat serving sleeping and dwelling units.<br><br>This code change may slightly increase the construction costs due to floor area threshold requirement. This change is expected to be cost-effective. This change will make the code equivalent to ASHRAE 90.1. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| C408.3 Functional testing of lighting and receptacle controls | CED1-84-22 | Renames the section title by adding the text "*and receptacle*." Now, this section includes a functional testing requirement for receptacle controls. It slightly increases construction costs due to additional code verification efforts. | Same as the change between the 2021 IECC and 2024 IECC. The 2023 FBCEC Section C408.3 title is slightly different. The impact of energy and construction costs is reflected in the subsections. | None | None |
| C408.3.1.2 Time-switch controls | | Revised Section C408.3.1.2 time-switch control requirements to include receptacle controls. It slightly increases construction costs due to additional code verification efforts. | Same as the change between the 2021 IECC and 2024 IECC. | None | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C408.3.1.4 High-end trim controls | CEPI-156-21, CECD1-4-22, CE2D-66-23 | Adds new Section C408.3.1.4. Lighting control verification requirement for High-end trim. | Same as the change between the 2021 IECC and 2024 IECC. | None | Increase |
| C408.3.1.5 High-end trim lighting control verification for L02 Additional Efficiency Credit | CECD1-4-22, CE2D-66-23 | Adds new Section C408.3.1.5. This section is used with additional efficiency credits. It may slightly increase construction costs due to the additional verification effort. This measure is expected to be cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| C408.3.1.6 Demand responsive lighting controls G01 | CEPI-156-21, CECD1-5-22, CE2D-67-23 | Adds new Section C408.3.1.6. This section is used with additional efficiency credits. It may slightly increase construction costs due to the additional verification effort. This measure is expected to be cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| **SECTION C409 CALCULATION OF THE HVAC TOTAL SYSTEM PERFORMANCE RATIO (New Section)** | | | | | |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C409 Calculation of the HVAC Total System Performance Ratio (TSPR) | CEPI-76-21 | Adds new Section C409.<br><br>The TRSP method is an alternative to the prescriptive or performance compliance method and is allowed for office, retail, hotel, motel, multifamily, dormitory, school, and library building use only. The compliance method excludes system types listed in the new subsection C409.2.1. TRSP is an optional compliance path; hence, it has no construction cost impact but provides compliance method flexibility. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| **Chapter C5: Existing Buildings** | | | | | |
| **SECTION C502 ADDITIONS** | | | | | |
| C502.3.7 Additional energy efficiency credit requirements | CEPI-217-21, CE2D-51-23 | Adds new Section C502.3.7. Additional energy efficiency credit requirement for building additions.<br><br>There are five exceptions to this requirement based on building occupancy group, additions gross floor size less than 1000 $ft^2$ and less than 50% of existing conditioned floor size, HVAC equipment type, additions that don't increase the conditioned floor area, and compliance with Section C407.<br>This change increases the stringency but is expected to be cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C502.3.8 Renewable energy systems | CECPI-2-21 | Adds new Section C502.3.8.<br><br>Additions must comply with the new Section C405.15's renewable energy system requirements. This change increases the stringency but is cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| **SECTION C503 ALTERATIONS** | | | | | |
| C503.2.1 Roof, ceiling, and attic alterations | CED1-144-22, CED1-147-22, CED1-145-22, CED1-146-22, CEPI-225-21, CEPI-221-21, CEPI-226-21, CE2D-69-23 | Renames the Section title and revises the code provisions for clarity of applicability. There is no change in stringency. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| C503.2.4 Above-grade wall alterations | CEPI-221-21 | Adds new Section C503.2.4. This change increases construction costs, but it is also cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| C503.2.5 Floor alterations | | Adds new Section C503.2.5. This change increases construction costs, but it is also cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| C503.2.6 Below-grade wall alterations | | Adds new Section C503.2.6. This change increases construction costs, but it is also cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C503.2.7 Air barrier | | Adds new Section C503.2.7. This change increases construction costs, but it is also cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| C503.3 Heating and cooling systems | CEPI-229-21 | Removes reference to Section C408 and moves it to the new subsection C503.3.2 for clarity. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| C503.3.2 Mechanical system acceptance testing | | Adds new Section C503.3.2.<br><br>This section adds a compliance requirement with relevant specific subsections C408.2.2, C408.2.3, and C408.2.5. This section has exceptions based on building size and type. The testing requirement may increase the stringency since it requires testing the unaltered portions of mechanical systems in existing buildings. This change increases construction costs, but it is also cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| C503.3.3 Duct testing | CEPI-219-21 | This adds a new Section C503.3.3. Existing ductwork is required to serve new equipment, and additions and alterations must be tested. This change increases construction costs, but it is also cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| C503.3.4 Controls | CEPI-227-21 | Adds new Section C503.3.4. Requires that thermostatic controls comply with current control requirements when equipment is replaced. This change is cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C503.3.5 System sizing | CEPI-228-21 | Adds new Section C503.3.5. Right-sized equipment, often smaller, generally has lower construction costs and saves operating energy costs. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Decrease |
| C503.3.6 Replacement or added roof-mounted mechanical equipment | CED1-148-22 | Adds new Section C503.3.6. This change increases construction costs. | Same as the change between the 2021 IECC and 2024 IECC. | None | Increase |
| Table C503.3.6 Roof-Mounted Mechanical Equipment Curb Heights | | Adds new Table C503.3.6. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| C503.4 Service hot water systems | CEPI-229-21 | Removes reference to Section C408 and moves the requirement to the new subsection C503.4.1. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| C503.4.1 Service hot water system acceptance testing | | Adds new subsection C503.4.1. Adds compliance requirement with specific subsections C408.2.3 and C408.2.5. This change my increase the stringency of the SHW testing requirements since it requires testing the unaltered portions of hot water systems in existing buildings. Acceptance testing confirms intended operational performance hence are expected to be cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| C503.6 Additional energy efficiency credit requirements for alterations | CED1-92-22, CED1-149-22, CED1-203-22, CEPI-217-21 | Adds new Section C503.6. Alterations that are substantial improvements must comply with efficiency measures from Sections C406.2, C406.3, or both to achieve the required energy credits specified in Table C406.1.1(1). There are four exceptions to the requirements of this section. This change increases the stringency but is cost-effective. | Same as the change between the 2021 IECC and 2024 IECC. | Decrease | Increase |
| **APPENDIX CD THE 2030 GLIDE PATH** | | | | | |
| Appendix CD The 2030 Glide Path | CEPI-257-21 | Adds new Appendix CD. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| **APPENDIX CE REQUIRED HVAC TOTAL SYSTEM PERFORMANCE RATIO (TSPR)** | | | | | |
| Appendix CE Required HVAC Total System Performance Ratio (TSPR) | CEPI76-21 | New Appendix CE. It is not mandatory unless specifically referenced in the adopting ordinance. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| **APPENDIX CF ENERGY CREDITS** | | | | | |
| Appendix CF Energy Credits | CEPI-193-21 | Ads new Appendix CF. It is not mandatory unless specifically referenced in the adopting ordinance. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| **APPENDIX CG ELECTRIC VEHICLE CHARGING INFRASTRUCTURE** | | | | | |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| Appendix CG Electric Vehicle Charging Infrastructure | CED1-15-22 | Adds new Appendix CG. It is not mandatory unless specifically referenced in the adopting ordinance. | The 2023 FBCEC has an almost identical provision in Appendix CC, which may require an update to make it equivalent. | None | None |
| **APPENDIX CH ELECTRIC-READY COMMERCIAL BUILDING PROVISIONS** | | | | | |
| Appendix CH Electric-Ready Commercial Building Provisions | CECD1-28-22 | Adds new Appendix CH. It is not mandatory unless specifically referenced in the adopting ordinance. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| **APPENDIX CI DEMAND RESPONSIVE CONTROLS** | | | | | |
| Appendix CI Demand Responsive Controls | CEAPP-01-24 | Adds new Appendix CI. It is not mandatory unless specifically referenced in the adopting ordinance. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| **APPENDIX CJ ELECTRICAL ENERGY STORAGE SYSTEM** | | | | | |
| Appendix CJ Electrical Energy Storage System | CEPI-7-21 | Adds new Appendix CJ. It is not mandatory unless specifically referenced in the adopting ordinance. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| **RESOURCES** | | | | | |
| **RESOURCE CRB THE 2030 GLIDE PATH (PRESCRIPTIVE)** | | | | | |
| Resource CRB The 2030 Glide Path (Prescriptive) | | Adds new Resource CRB. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |

| 2024 IECC Section and Title | ICC Code Change No. | Change Summary b/t 2021 IECC and 2024 IECC | Change Summary b/t 2023 FBC-EC and 2024 IECC | Anticipated Energy Impact on FBC-EC if Adopted* | Anticipated Cost Impact on FBC-EC if Adopted* |
|---|---|---|---|---|---|
| **RESOURCE CRA ALL-ELECTRIC COMMERCIAL BUILDING PROVISIONS** | | | | | |
| Resource CRA All-Electric Commercial Building Provisions | | Adds new Resource CRA. | Same as the change between the 2021 IECC and 2024 IECC. | None | None |
| **Chapter C6: Referenced Standards** | | | | | |
| | | | | | |

***** FSEC assessment of energy and cost impacts is consistent with those in the 2024 I-Codes Revision History unless otherwise noted.

## Appendix-B: Additional Energy Efficiency Measures

The IECC-based 2023 FBC has seven additional efficiency measures, but a 10% cooling efficiency increase was used across all sixteen prototype buildings. The 2024 IECC has 39 measures to choose from, and 11 were used to analyze the 2024 IECC commercial prototype buildings model. To meet the target energy credits, 3 to 7 additional efficiency measures were used depending on building occupancy groups and climate zones. The additional energy efficiency measures used by building occupancy groups and climate zones are summarized in Table B-1 through Table B-9.

### Apartments

Table B-1 summarizes three energy credit measures selected and the target and achievable energy credits for apartment prototype buildings.

Table B-1 Target and achievable energy credits for apartment buildings by climate zones

| Energy Credit Measures | ID | 1A | 2A |
|---|---|---|---|
| Reduced Air Leakage | E03 | | 6 |
| Add Roof Insulation | E04 | | |
| Add Wall Insulation | E05 | | |
| Improve Fenestration | E06 | | |
| Cooling Efficiency | H03 | 8 | 6 |
| Heat Pump Water Heater | W02 | 62 | 72 |
| Efficient Gas Water Heater | W03 | | |
| Commercial Kitchen Equipment | Q03 | | |
| Lighting Occupancy Sensor | L03 | | |
| Reduced Lighting Power | L06 | | |
| Renewable Energy | R01 | | |
| Target Energy Credits | | 67 | 80 |
| Achievable Energy Credits | | 70 | 84 |

### Hospitals

Table B-2 summarizes the energy credit measures selected and target and achievable energy credits for hospital prototype building.

Table B-2 Target and achievable energy credits for hospital prototype buildings by climate zones

| Energy Credit Measures | ID | 1A | 2A |
|---|---|---|---|
| Reduced Air Leakage | E03 | | |
| Add Roof Insulation | E04 | | |
| Add Wall Insulation | E05 | | |
| Improve Fenestration | E06 | | |
| Cooling Efficiency | H03 | 16 | 12 |
| Heat Pump Water Heater | W02 | | |

| | | | |
|---|---|---|---|
| Efficient Gas Water Heater | W03 | | |
| Commercial Kitchen Equipment | Q03 | | |
| Lighting Occupancy Sensor | L03 | 5 | 5 |
| Reduced Lighting Power | L06 | 14 | 14 |
| Renewable Energy | R01 | 6 | 6 |
| Target Energy Credits | | 38 | 36 |
| Achievable Energy Credits | | 41 | 37 |

## Outpatient Health Care

Table B-3 summarizes the selected energy credit measures, targets, and achievable energy credits for the outpatient healthcare prototype building.

Table B-3 Target and achievable energy credits for outpatient prototype buildings by climate zones

| Energy Credit Measures | ID | 1A | 2A |
|---|---|---|---|
| Reduced Air Leakage | E03 | | 2 |
| Add Roof Insulation | E04 | | |
| Add Wall Insulation | E05 | | |
| Improve Fenestration | E06 | 4 | 7 |
| Cooling Efficiency | H03 | 16 | 12 |
| Heat Pump Water Heater | W02 | | |
| Efficient Gas Water Heater | W03 | 6 | 7 |
| Commercial Kitchen Equipment | Q03 | | |
| Lighting Occupancy Sensor | L03 | 6 | 6 |
| Reduced Lighting Power | L06 | 16 | 16 |
| Renewable Energy | R01 | 17 | 17 |
| Target Energy Credits | | 64 | 66 |
| Achievable Energy Credits | | 65 | 67 |

## Hotels

Table B-4 summarizes the energy credit measures selected and the targets and achievable energy credits for the large and small hotel prototype buildings. The efficient gas water heater efficiency water heater capacity does not exceed 60% of the total water heating load.

Table B-4 Target and achievable energy credits for hotel prototype buildings by climate zones

| Energy Credit Measures | ID | 1A | 2A |
|---|---|---|---|
| Reduced Air Leakage | E03 | 12 | 6 |
| Add Roof Insulation | E04 | | |
| Add Wall Insulation | E05 | | |
| Improve Fenestration | E06 | 1 | |
| Cooling Efficiency | H03 | 16 | 12 |
| Heat Pump Water Heater | W02 | 18 | 20 |

| | | | |
|---|---|---|---|
| Efficient Gas Water Heater | W03 | | 16 |
| Commercial Kitchen Equipment | Q03 | | |
| Lighting Occupancy Sensor | L03 | 3 | 3 |
| Reduced Lighting Power | L06 | 4 | 4 |
| Renewable Energy | R01 | 12 | 11 |
| Target Energy Credits | | 66 | 70 |
| Achievable Energy Credits | | 66 | 72 |

## Restaurants

Table B-5 summarizes the energy credit measures selected and the targets and achievable energy credits for the fast-food and full-service restaurant prototype buildings. The efficient gas water heater efficiency water heater capacity does not exceed 60% of the total water heating load.

Table B-5 Target and achievable energy credits for restaurant prototype buildings by climate zones

| Energy Credit Measures | ID | 1A | 2A |
|---|---|---|---|
| Reduced Air Leakage | E03 | | |
| Add Roof Insulation | E04 | | |
| Add Wall Insulation | E05 | | |
| Improve Fenestration | E06 | | |
| Cooling Efficiency | H03 | 12 | 12 |
| Heat Pump Water Heater | W02 | 19 | 21 |
| Efficient Gas Water Heater | W03 | 5 | 6 |
| Commercial Kitchen Equipment | Q03 | 28 | 28 |
| Lighting Occupancy Sensor | L03 | | |
| Reduced Lighting Power | L06 | 6 | 6 |
| Renewable Energy | R01 | 2 | 2 |
| Target Energy Credits | | 72 | 75 |
| Achievable Energy Credits | | 72 | 75 |

## Retails

Table B-6 summarizes the selected energy credit measures, targets, and achievable energy credits for the standalone and strip mall retail prototype building.

Table B-6 Target and achievable energy credits for retail prototype buildings by climate zones

| Energy Credit Measures | ID | 1A | 2A |
|---|---|---|---|
| Reduced Air Leakage | E03 | | |
| Add Roof Insulation | E04 | | 7 |
| Add Wall Insulation | E05 | 48 | 13 |
| Improve Fenestration | E06 | | |
| Cooling Efficiency | H03 | 14 | 20 |
| Heat Pump Water Heater | W02 | | |
| Efficient Gas Water Heater | W03 | | |
| Commercial Kitchen Equipment | Q03 | | |
| Lighting Occupancy Sensor | L03 | | |
| Reduced Lighting Power | L06 | 14 | 30 |
| Renewable Energy | R01 | 12 | 11 |
| Target Energy Credits | | 83 | 81 |
| Achievable Energy Credits | | 88 | 81 |

## Schools

Table B-7 summarizes the energy credit measures selected and the targets and achievable energy credits for the primary and secondary school prototype building.

Table B-7 Target and achievable energy credits for school prototype buildings by climate zones

| Energy Credit Measures | ID | 1A | 2A |
|---|---|---|---|
| Reduced Air Leakage | E03 | | |
| Add Roof Insulation | E04 | | |
| Add Wall Insulation | E05 | 4 | 3 |
| Improve Fenestration | E06 | 6 | 11 |
| Cooling Efficiency | H03 | 12 | 10 |
| Heat Pump Water Heater | W02 | | |
| Efficient Gas Water Heater | W03 | 6 | 6 |
| Commercial Kitchen Equipment | Q03 | | |
| Lighting Occupancy Sensor | L03 | | |
| Reduced Lighting Power | L06 | 14 | 16 |
| Renewable Energy | R01 | 13 | 13 |
| Target Energy Credits | | 55 | 58 |
| Achievable Energy Credits | | 55 | 59 |

## Storage (Warehouse)

Table B-8 summarizes the selected energy credit measures, targets, and achievable energy credits for non-refrigerated warehouse prototype buildings.

Table B-8 Target and achievable energy credits for warehouse prototype buildings by climate zones

| Energy Credit Measures | ID | 1A | 2A |
|---|---|---|---|
| Reduced Air Leakage | E03 | 1 | |
| Add Roof Insulation | E04 | | |
| Add Wall Insulation | E05 | | |
| Improve Fenestration | E06 | | |
| Cooling Efficiency | H03 | 10 | 8 |
| Heat Pump Water Heater | W02 | | |
| Efficient Gas Water Heater | W03 | | |
| Commercial Kitchen Equipment | Q03 | | |
| Lighting Occupancy Sensor | L03 | | |
| Reduced Lighting Power | L06 | 34 | 34 |
| Renewable Energy | R01 | 16 | 16 |
| Target Energy Credits | | 61 | 58 |
| Achievable Energy Credits | | 61 | 58 |

## Others

Table B-9 summarizes the energy credit measures selected and the targets and achievable energy credits for large, medium, and small office prototype buildings.

Table B-9 Target and achievable energy credits for office prototype buildings by climate zones

| Energy Credit Measures | ID | 1A | 2A |
|---|---|---|---|
| Reduced Air Leakage | E03 | | |
| Add Roof Insulation | E04 | | |
| Add Wall Insulation | E05 | | |
| Improve Fenestration | E06 | | |
| Cooling Efficiency | H03 | 10 | 8 |
| Heat Pump Water Heater | W02 | | |
| Efficient Gas Water Heater | W03 | | |
| Commercial Kitchen Equipment | Q03 | | |
| Lighting Occupancy Sensor | L03 | | |
| Reduced Lighting Power | L06 | 8 | 8 |
| Renewable Energy | R01 | 16 | 16 |
| Target Energy Credits | | 31 | 32 |
| Achievable Energy Credits | | 34 | 32 |

## Appendix-C: Florida Energy Rates

The analysis used a constant electric energy rate obtained from EIA[1]. It is customary for DOE to use fixed energy rates for the U.S. National Building Energy Code analysis during the tri-annual code development cycle. The September 2024 electric energy rates in Table C-1 were used for the analysis. The analysis used the 2023 and 2024 electric energy rates to determine the cost-effectiveness of some of the measures.

Table C-1 Standard Electricity Rates for Florida

| | Electric Energy Rates, $/kWh | Energy Rates, DOE[2] |
|---|---|---|
| September 2023 | 0.1189 | $0.1099/kWh<br>$0.983/therm |
| September 2024 | 0.1160 | |

The average natural gas rate used for the analysis was $11.415 /1000 cup ($1.0141/therm), obtained from the EIA. Tables C-2 and C-3 provide the electricity and natural gas price escalation factors used in the cost-benefit analysis.

Table C-2 Use Price Escalation for Florida Commercial-Electricity

| Escalation Year | Use Price Escalation Value |
|---|---|
| 1 | 0.9849 |
| 2 | 0.9592 |
| 3 | 0.9388 |
| 4 | 0.9275 |
| 5 | 0.9268 |
| 6 | 0.9314 |
| 7 | 0.9381 |
| 8 | 0.9402 |
| 9 | 0.9388 |
| 10 | 0.9377 |
| 11 | 0.9412 |
| 12 | 0.9458 |
| 13 | 0.9402 |
| 14 | 0.9353 |
| 15 | 0.9258 |
| 16 | 0.9170 |
| 17 | 0.9141 |
| 18 | 0.9117 |
| 19 | 0.9050 |
| 20 | 0.9001 |
| 21 | 0.8948 |
| 22 | 0.8860 |
| 23 | 0.8821 |

[1] https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=table_5_06_a
[2] Methodology | Building Energy Codes Program

| | |
|---|---|
| 24 | 0.8783 |
| 25 | 0.8758 |
| 26 | 0.8758 |
| 27 | 0.8733 |
| 28 | 0.8652 |
| 29 | 0.8631 |
| 30 | 0.8631 |

Table C-3 Use Price Escalation for Florida Commercial-Natural Gas

| Escalation Year | Use Price Escalation Value |
|---|---|
| 1 | 0.9922 |
| 2 | 0.9734 |
| 3 | 0.9635 |
| 4 | 0.9657 |
| 5 | 0.9767 |
| 6 | 0.9889 |
| 7 | 1.0055 |
| 8 | 1.0144 |
| 9 | 1.0221 |
| 10 | 1.0277 |
| 11 | 1.0365 |
| 12 | 1.0421 |
| 13 | 1.0421 |
| 14 | 1.0432 |
| 15 | 1.0465 |
| 16 | 1.0498 |
| 17 | 1.052 |
| 18 | 1.0554 |
| 19 | 1.0587 |
| 20 | 1.0598 |
| 21 | 1.0609 |
| 22 | 1.0576 |
| 23 | 1.0565 |
| 24 | 1.0565 |
| 25 | 1.0576 |
| 26 | 1.0587 |
| 27 | 1.0598 |
| 28 | 1.0609 |
| 29 | 1.0609 |
| 30 | 1.0609 |

# Appendix-D: Florida Commercial Building Floor Area Distribution

## Floor Area Weighting Factors Determination

The conditioned floor area weighting factors used in this study were generated by processing building stock information from a PNNL latest report (Lei et al., 2020). The information obtained includes total floor areas by building type for Florida and national average building weighting factors by climate zones. The Florida average weighting factors by building type and climate zones 1A and 2A were obtained directly from the PNNL report. Two sets of weighting factors were generated for this investigation: weighting factors for the two Florida climate zones for each prototype building type and the state's average weighting factors by building type and climate zone. The former weighting factors for climate zones 1A and 2A were used to estimate the EUI for each of the sixteen prototype buildings in Florida. The later weighting factors were used to determine an aggregate EUI across the sixteen commercial prototype buildings for the state of Florida. Table D-1 summarizes commercial buildings' total floor area stock distribution by prototype building in Florida.

Table D-1 Commercial Prototype Buildings Floor Area Distribution in Florida

| Building Type | Prototype Building | Prototype Building Floor Area, $ft^2$ | Sample Total Building Floor Area, 1000 $ft^2$ | Floor Area Weighting Factors, % |
|---|---|---|---|---|
| Office | Small Office | 5,502 | 60,118 | 4.27 |
| | Medium Office | 53,628 | 59,533 | 4.27 |
| | Large Office | 498,588 | 28,515 | 2.06 |
| Retail | Stand-Alone Retail | 24,692 | 132,725 | 9.57 |
| | Strip Mall | 22,500 | 64,402 | 4.71 |
| Education | Primary School | 73,959 | 55,681 | 3.98 |
| | Secondary School | 210,887 | 95,221 | 6.77 |
| HealthCare | Outpatient Health Care | 40,946 | 36,318 | 2.65 |
| | Hospital | 241,501 | 51,718 | 3.68 |
| Lodging | Small Hotel | 43,202 | 16,958 | 1.33 |
| | Large Hotel | 122,120 | 64,988 | 4.57 |
| Warehouse | Non-Refrigerated Warehouse | 52,045 | 235,608 | 16.94 |
| Food Service | Quick Service Restaurant | 2,501 | 12,756 | 1.03 |
| | Full Service Restaurant | 5,502 | 4,850 | 0.29 |
| Apartment | Mid-Rise Apartment | 33,741 | 181,057 | 12.96 |
| | High-Rise Apartment | 84,360 | 292,976 | 20.91 |
| Total | | 1,515,674 | 1393,424 | 100.00 |

## Floor Area Weighting Factors by Florida Climate Zones

Figure D-1 shows Florida's weighting factors by climate zones and prototype building type. The weighting factors for each prototype building type sum to 1.0. These weighting factors split the total floor area stock of each prototype building in the state into climate zone 1A and 2A fractions. For instance, for High Rise Apartments, 68.3% of the total floor area in Florida is in climate zone 1A, and the remaining 31.7% is in climate zone 2A.

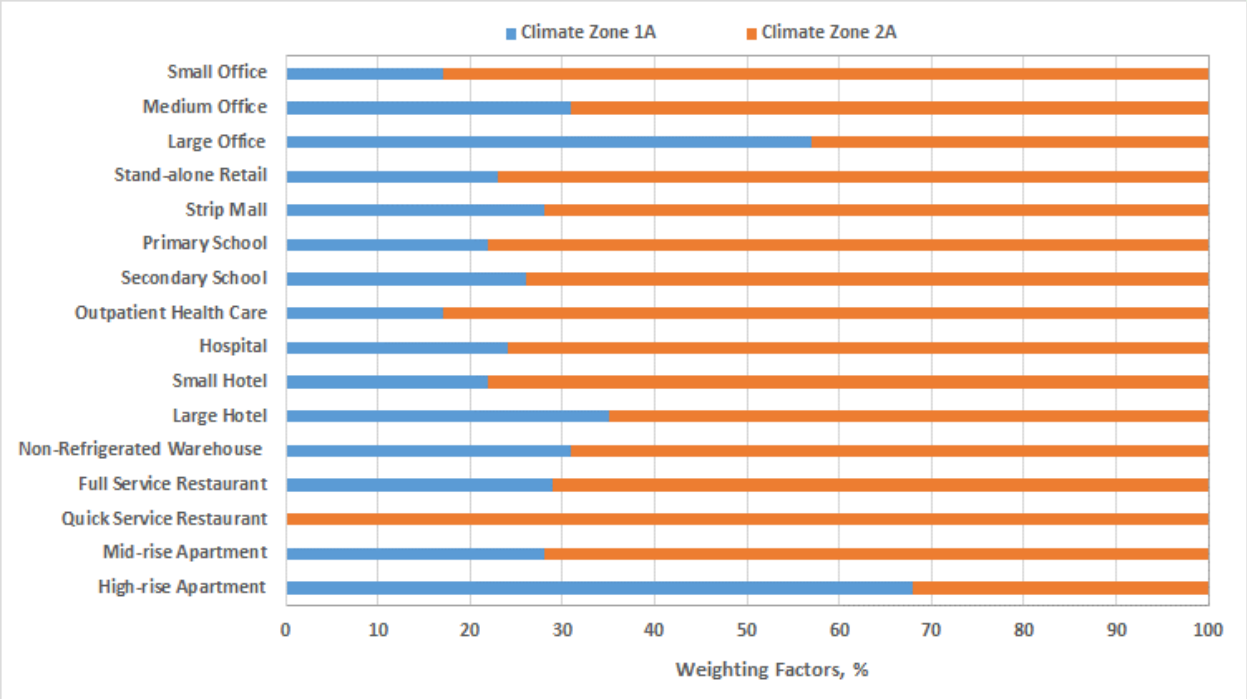


Figure D-1 Florida Floor Area Weighting Factors by Climate Zone and Building Type

## Average Floor Area Weighting Factors by Building Type

The average weighting factors were used to determine an aggregate EUI across the sixteen prototype building types for the State. The weighting factors across the sixteen prototype buildings and the two climate zones sum to 1. Figure D-2 shows Florida's average weighting factors by building type (sum of climate zones 1A and 2A). The High-Rise Apartment building type represents the highest fraction of total floor area stock in Florida, and it is 20.91% of Florida commercial buildings' entire floor area stock. Warehouse and Mid-Rise apartment commercial prototype buildings are the State's second and third largest by floor area, respectively.

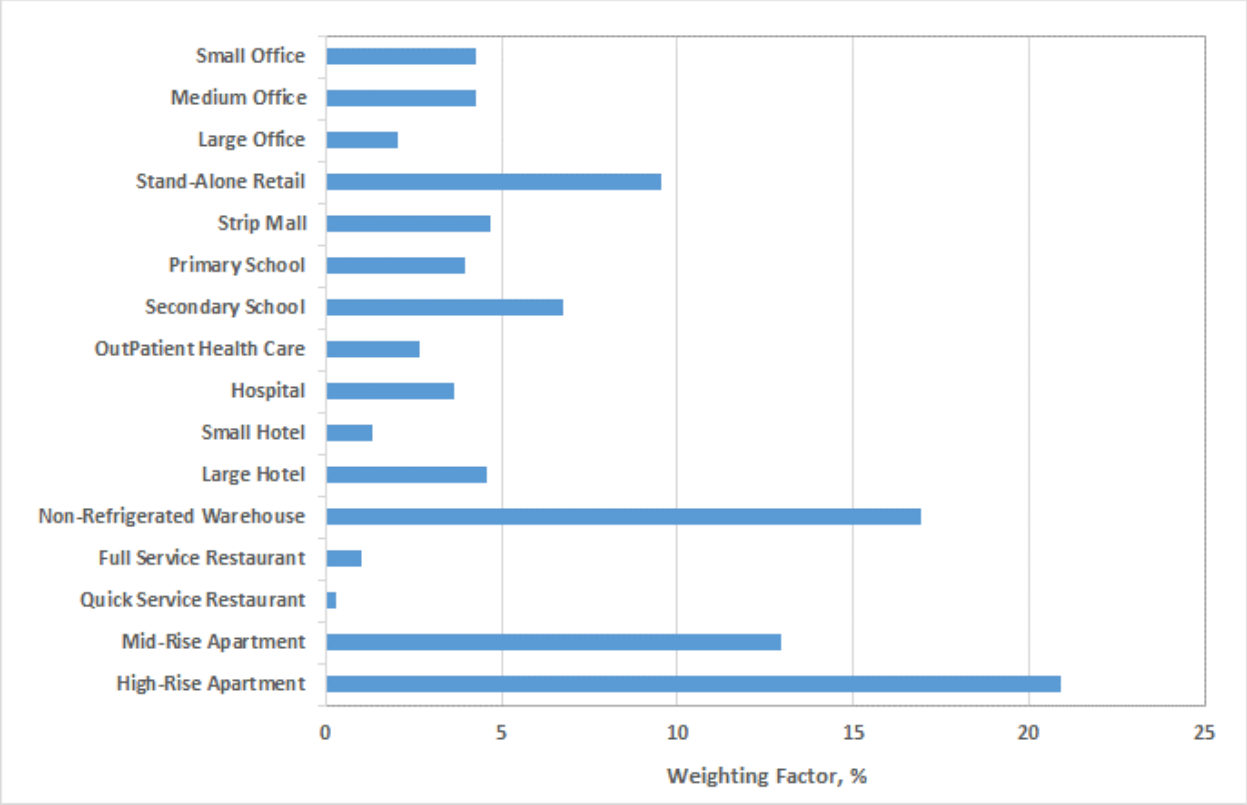


Figure D-2 Commercial Buildings Floor Area Weighting Factors by Prototype Building

The commercial building conditioned floor area distribution for the State of Florida presented here was obtained from data published by PNNL (Lei et al., 2020). Florida's commercial building conditioned floor area distribution by climate zones and building type were determined from recent construction data compiled by PNNL for building energy analysis.

# Appendix-E: Cost-Effectiveness Analysis of Code Modifications

Life Cycle cost analysis determined the cost-effectiveness of selected code modifications between the IECC-based 2023 FBC-EC and the 2024 IECC. Cost-effectiveness analysis used annual energy savings determined between the base case, the 8th Edition (2023) Florida Building Code, Energy Conservation, and the 2024 IECC. This requires creating a baseline and an upgrade code for each code modification whose energy savings potential can be determined through simulation. The total annual and life cycle energy costs were computed using Florida energy rates for electricity and natural gas and energy price escalation rates summarized in Appendix C. The code modification, along with a brief description of the change, energy, and construction cost impacts, are provided in Appendix A. Code modifications whose energy impact cannot be analyzed quantitatively, code modifications with no or negligible net first cost, federal minimum code modifications, or those code changes cannot be represented in the existing prototype buildings model are excluded from cost-effectiveness analysis.

## Cost-benefit Analysis of the Code Modifications

This section describes the cost-benefit analysis, the assumptions used in the analysis, the energy-saving potential, and the SIR value for each of the 2024 IECC code modifications considered for cost-effectiveness analysis. Six code modifications were analyzed for cost-effectiveness and presented next.

### C403.7.1 Demand Control Ventilation (CEPI-110-21)

The 2024 IECC revised the demand-controlled ventilation requirements. In section C403.7.1 Demand control ventilation, the 2021 and 2024 IECC people occupancy density threshold for demand control ventilation is 15 people or greater per 1,000 $ft^2$ of floor area. In contrast, the 2023 FBC-EC people occupancy density threshold demand control ventilation is 25 people or greater per 1,000 $ft^2$ of floor area. The 2024 IECC requires demand control ventilation in spaces with an occupant density of 15 people or greater per 1,000 $ft^2$. However, spaces served by a single-zone system are not required to meet the occupant density threshold. Still, they require DCV so long as the single zone system has an air-economizer and does not have an energy recovery system. Demand-control ventilation is a requirement in spaces with air economizers, but there are exceptions depending on the space's floor area, occupant density, and energy recovery. The floor area threshold for exemption is dependent on the climate zone.

The retail and secondary school prototype buildings were selected for the analysis. The baseline assumed no demand control ventilation per the 2023 FBC-EC, and the upgrade has demand control ventilation per the 2024 IECC. The analysis was done in climate zone 2A only since the change did not impact climate zone 1A for these prototype buildings and was applied to the spaces impacted by the 2024 IECC code changes only.

**Annual Energy Savings:** Simulation of the modified retail prototype buildings for baseline representing the 8th Edition (2023) FBC-EC and the upgrade representing the 2024 IECC demonstrate the annual energy saving potentials. The electric, gas, and total net annual energy savings of these prototype buildings are summarized in Table E-1.

Table E-1 Annual Energy Savings for Demand Control Ventilation by Building Type

| Prototype Building | City | Electric Energy Savings, kWh | Gas Energy Savings, kWh | Total Energy Savings, kWh |
|---|---|---|---|---|
| Retail Strip Mall | Miami | 0 | 0 | 0 |
| | Tampa | 5611 | 2347 | 7958 |
| Secondary School | Miami | 0 | 0 | 0 |
| | Tampa | 15861 | 28 | 15889 |
| Weighted Average | | 8568 | 704 | 9273 |

**Investment Cost:** The incremental cost of adding demand control ventilation is, thus, the cost of CO2 sensors. The incremental installed cost for CO2 sensors was assumed to be $300 per space, with an annual maintenance cost of $30 and a service life of 15 years. For example, the retail prototype building has ten retail spaces, each served by a single zone system. The total incremental first and annual maintenance costs for the retail buildings were $3000 and $300, respectively. Similarly, secondary school buildings' capital and annual maintenance incremental costs were $1200 and $120, respectively. Only four space types were affected in the secondary school buildings.

**Cost-Benefit Analysis:** The cost-benefit analysis was determined using the above incremental first and annual recurring maintenance costs, a service life span of 15 years, and annual energy cost savings determined using simulation for the retail and secondary school prototype building. Table E-2 summarizes the cost-benefit analysis results for the two climate zones and a weighted average for Florida.

Table E-2 Cost-benefit analysis results summary for Demand Control Ventilation

| Building Type | City | Life Cycle Energy Cost Savings NPV, $ | Net Investment Cost NPV, $ | SIR |
|---|---|---|---|---|
| Retail Strip Mall | Miami | 0 | 0 | 0 |
| | Tampa | 6444 | 5413 | 1.19 |
| Secondary School | Miami | 0 | 0 | 0 |
| | Tampa | 15854 | 2165 | 7.32 |
| Weighted Average | | 12057 | 3476 | 3.47 |

**Summary:** The cost-effectiveness of demand control ventilation requirements was investigated in a retail and school prototype building in climate zone 2A. The weighted average SIR across the retail and secondary school prototype buildings was 3.47, which is cost-effective. Therefore, the demand control ventilation change meets the cost-benefit criteria and is recommended for consideration by the Florida Building Commission for addition to the 9th Edition (2026) Florida Building Code, Energy Conservation.

### C403.7.8 Occupied Standby Controls (CEPI-108-21)

Add a new definition for "occupied standby mode" and new ventilation air requirements for zones in occupied standby mode. This code changes cooling and heating thermostats by at least 1.0°F (0.56°C) for zones served in occupied standby mode. It reduces the zone ventilation air requirement to zero (shuts off the supply air) when the space temperature floats between the heating and cooling set points. Furthermore, this code change is intended to tie occupied-standby mode to occupant sensor lighting control requirement in section C405.2.1, i.e., when a space is not occupied for more than 20 minutes, lighting is turned off automatically. In summary, there are two changes for "occupied-standby controls":

- Set the heating thermostat back or set the cooling thermostat up by 1.0 °F when the space is planned for "occupied-standby mode."
- Turn off ventilation air supply when a space is planned for "occupied-standby mode" for a single zone or a multi-zone system

This change was tested in four prototype buildings: a small office, a large office, a primary school, and a small hotel. To model this code change, office space heating and cooling thermostat set-point temperatures were set back and set up, respectively. The cycle-off supply air fan or reduced ventilation air to zero two or three times a day for an hour during occupied standby mode.

**Annual Energy Saving:** The simulation of these four prototype buildings with and without "occupied-standby mode" control results in annual energy savings. The net energy savings by building type are summarized in Table E-3.

Table E-3 Annual Energy Cost Saving by Building Type for Occupied Standby Control

| Prototype Building | City | Electric Energy Saving, kWh | Gas Energy Saving, kWh | Total Energy Saving, kWh |
|---|---|---|---|---|
| Small Office | Miami | 183 | 0 | 183 |
| | Tampa | 208 | 0 | 208 |
| Large Office | Miami | 2297 | -100 | 2197 |
| | Tampa | 919 | 453 | 1372 |
| Primary School | Miami | 192 | 0 | 192 |
| | Tampa | 72 | -3 | 69 |
| Small Hotel | Miami | 1567 | 11 | 1578 |
| | Tampa | 1528 | 0 | 1528 |
| Weighted Average | | 586 | 24 | 610 |

**Investment Cost:** An occupancy sensor for lighting control is already required in selected space types such as offices, employee meetings, and lounge spaces. No incremental cost is incurred for thermostat setback or setup control since the occupancy sensors used for lighting control can also be used for occupied standby control. HVAC ventilation control may be the only component that incurs additional costs, and current HVAC control comes with the capability of integrated

control technologies for ventilation and lighting control based on occupancy. As a result, the incremental first, installation, and maintenance costs are small as the occupancy sensor control is required by code for lighting controls for the selected space types. Therefore, installed incremental costs of $40.0, annual maintenance costs of $10.0, and a service life span of 12 years were assumed for each device serving each space controlled.

**Cost-Benefit Analysis**: Cost-effectiveness was determined using incremental first and maintenance costs, 12 years of service life, and annual energy savings determined using a simulation of the seven prototype buildings. Table E-4 summarizes the net present value of the Life Cycle Energy Cost Savings, the net present value of investment cost, and the saving-to-investment ratio for the two climate zones.

Table E-4 Cost-benefit Analysis Results Summary Occupied Standby Control

| Building Type | City | Life Cycle Energy Cost Saving NPV, $ | Investment Cost NPV, $ | SIR |
|---|---|---|---|---|
| Small Office | Miami | 153 | 108 | 1.42 |
| | Tampa | 176 | 108 | 1.63 |
| Large Office | Miami | 1898 | 1081 | 1.76 |
| | Tampa | 905 | 1081 | 0.84 |
| Primary School | Miami | 157 | 108 | 1.45 |
| | Tampa | 53 | 108 | 0.49 |
| Small Hotel | Miami | 1317 | 216 | 6.09 |
| | Tampa | 1283 | 216 | 5.93 |
| Weighted Average | | 497 | 293 | 1.70 |

The small office, large office, primary school, and small hotel prototype buildings show annual energy cost and annual energy saving, and their average SIR values by prototype building were 1.59, 1.36, 0.70, and 5.97, respectively. Since the single zone packaged HVAC system types are used in small offices, small hotels, and primary school buildings serving individual spaces, the ventilation control is achieved by turning the supply fan off along with the thermostat setback and setup, which will essentially turn off the HVAC system. This results in higher energy savings for this change. However, the same scale of energy saving may not be realized for spaces served by central system types used in large-size buildings. Setting ventilation airflow to zero in individual air terminal VAV box equipment does not result in significant energy savings as the central HVAC system and supply fan are not entirely off. As a result, we see different energy savings potential depending on the HVAC system.

**Summary:** A cost-benefit analysis demonstrated that the weighted average SIR value for the small office, small hotel, and primary school prototype buildings is 1.70; hence, this code change is cost-effective. Therefore, it is recommended that the Florida Building Commission consider this change for addition to the 9$^{th}$ Edition (2026) Florida Building Code, Energy Conservation.

**C403.10 Buildings with High-Capacity Space-Heating Gas Boiler System (CEPI-77-21)**

This code modification is a new requirement for high-capacity space-heating condensing gas boilers per Section C403.10 and subsections C403.10.1 and C403.10.2. These modifications require a condensing gas boiler and hot water distribution system that enables lower return water temperature and higher thermal efficiency for a high-capacity space-heating boiler. In summary, there are two changes for high-capacity space-heating boiler systems:

- Increase the thermal efficiency of condensing gas boiler to 90% for space heating applications with a capacity range from 1.0 million Btu/r to 10.0 million Btu/h per section C403.10.1.
- In the design and all operating conditions, the return water temperature must not exceed 120°F per Section C403.10.2.

This change was tested in three prototype buildings: a large office, a secondary school, and a hospital.

To model this code change, the boiler thermal efficiency was increased to 90.0%, a return water temperature control set-point manager was added, the hot water plant loop sizing hot water supply temperature was reduced to 60°C, and the hot water loop design temperature difference was increased. The later change provides flexibility on the return temperature control and also allows a lower supply temperature at a higher hot water flow to the hot water heating coils.

**Annual Energy Saving:** The simulation of these three prototype buildings with and without code modification results in annual energy savings. The net energy savings by building type are summarized in Table E-5.

Table E-5 Annual Energy Cost Saving for High-Capacity Space-Heating Gas Boiler System

| Prototype Building | City | Electric Energy Saving, kWh | Gas Energy Saving, kWh | Total Energy Saving, kWh |
|---|---|---|---|---|
| Large Office | Miami | 0 | 139 | 139 |
| | Tampa | 72 | 3,347 | 3,419 |
| Secondary School | Miami | -92 | 10,308 | 10,217 |
| | Tampa | -222 | 11,025 | 10,803 |
| Hospital | Miami | -4078 | 138,292 | 134,214 |
| | Tampa | -4278 | 146,092 | 141,814 |
| Weighted Average | | -1341 | 48,532 | 47,191 |

**Investment Cost:** For space-heating gas applications, a first and installation cost of $38.5 for non-condensing and $42.8 for condensing gas boilers per 1000 Btu/h was assumed. An incremental annual maintenance cost of $400.0 and a service life span of 25 years were also assumed. The capital installation and maintenance costs were based on assumptions obtained from the 2024 IECC change history document. The installed capital cost varies by the heating capacity.

**Cost-Benefit Analysis:** Cost-effectiveness was determined using incremental first and maintenance costs, 25 years of service life span, and annual energy savings determined using a simulation of the three prototype buildings. Table E-6 summarizes the net present value of the Life Cycle Energy Cost Savings, the net present value of investment cost, and the saving-to-investment ratio for the two climate zones.

Table E-6 Cost-benefit Analysis Results for High-Capacity Space-Heating Gas Boiler System

| Building Type | City | Life Cycle Energy Cost Saving NPV, $ | Investment Cost NPV, $ | SIR |
|---|---|---|---|---|
| Large Office | Miami | 65 | 4902 | 0.00 |
| | Tampa | 1791 | 5167 | 0.07 |
| Secondary School | Miami | 5081 | 6118 | 0.41 |
| | Tampa | 5265 | 6722 | 0.42 |
| Hospital | Miami | 64173 | 23455 | 2.21 |
| | Tampa | 67834 | 24592 | 2.33 |
| Weighted Average | | 22626 | 19240 | 1.18 |

The large office, secondary school, and hospital prototype buildings show annual energy cost and annual energy use saving, and their average SIR values by prototype building were 0.03, 0.42, and 2.30, respectively. SIR values vary widely by building occupancy type and climate zones. The office and secondary school prototype buildings don't operate during the night when most of the space heating load is anticipated; hence, the energy savings potential is limited, whereas the hospital prototype building, which operates 24 hours, realized a higher annual space heating energy savings.

**Summary:** Cost-benefit analysis demonstrated that for the large office, secondary school, and hospital prototype buildings, the average SIR value is 1.18. This code modification is more favorable in climate zone 2A than 1A. It is cost-effective in building occupancy groups that operate 24 hours, such as hospital buildings. Therefore, depending on the building occupancy group, this code change is recommended for consideration by the Florida Building Commission for addition to the 9$^{th}$ Edition (2026) Florida Building Code, Energy Conservation.

**Interior Lighting Power Density Reduction (CECPI-7-21)**

The 2024 IECC reduces the interior lighting power density (LPD) for the building area method in Table C405.3.2(1). The building area method LPD values were reduced for all building area types except the convention center, exercise center, fire station, library, manufacturing facility, and warehouse. The code change also reduces the interior lighting power density (LPD) for the space-by-space method in Table C405.3.2(2). The LPD values were reduced for most space types.

This change impacts all sixteen prototype buildings. The three office prototype buildings use the building area method, and the remaining thirteen prototype buildings use the space-by-space method for interior lighting power calculation. Table E-7 provides floor area weighted interior LPD for the 2023 FBC-EC and the 2024 IECC by prototype buildings. The lighting LPD reduction for the warehouse prototype building was 0.55% because the LPD values for the storage space types, which account for 95.1% of the warehouse building, did not change between the 2023 FBC-EC and the 2024 IECC.

Table E-7 Interior LPD values for the 2023 FBC-EC and the 2024 IECC by building type

| Prototype Building | Calculation Method | 2023 FBC-EC, W/ft$^2$ | 2024 IECC, W/ft$^2$ | Reduction, Percent |
|---|---|---|---|---|
| Small Office | Building Area | 0.64 | 0.62 | 3.13 |
| Medium Office | | 0.64 | 0.62 | 3.13 |
| Large Office | | 0.64 | 0.62 | 3.13 |
| Retail Standalone | Space-by-Space | 0.95 | 0.90 | 4.98 |
| Hospital | | 0.93 | 0.88 | 5.10 |
| Large Hotel | | 0.55 | 0.51 | 5.71 |
| Warehouse | | 0.447 | 0.445 | 0.55 |
| Full-Service Restaurant | | 0.73 | 0.70 | 4.21 |

**Annual Energy Savings:** Table E-8 summarizes the annual energy savings due to interior LPD reduction building type and climate zones, which were determined using simulations. The energy savings include the LPD reduction impact on HVAC system cooling and heating operations.

Table E-8 Annual Energy Cost Savings for Interior Lighting LPD Change by Building Type

| Prototype Building | City | Electric Energy Savings, kWh | Gas Energy Savings, kWh | Total Energy Savings, kWh |
|---|---|---|---|---|
| Small Office | Miami | 353 | 0 | 353 |
| Small Office | Tampa | 350 | 0 | 350 |
| Medium Office | Miami | 2547 | 0 | 2547 |

| | | | | |
|---|---|---|---|---|
| Medium Office | Tampa | 2556 | -6 | 2550 |
| Large Office | Miami | 32758 | -6 | 32753 |
| Large Office | Tampa | 28531 | -117 | 28414 |
| Stand-Alone Retail | Miami | 4081 | -3 | 4078 |
| Stand-Alone Retail | Tampa | 4014 | -58 | 3956 |
| Hospital | Miami | 66878 | 3486 | 70364 |
| Hospital | Tampa | 65497 | 4061 | 69558 |
| Large Hotel | Miami | 10819 | -22 | 10797 |
| Large Hotel | Tampa | 10722 | -1178 | 9544 |
| Non-Refrigerated Warehouse | Miami | 369 | 0 | 369 |
| Non-Refrigerated Warehouse | Tampa | 328 | -6 | 322 |
| Full-Service Restaurant | Miami | 836 | -14 | 822 |
| Full-Service Restaurant | Tampa | 767 | -94 | 672 |

**Investment Installed Cost**

The IECC-2024 interior LPD upgrade does not anticipate a construction cost increase since the same LED technology is used for the baseline and the upgrade. This change is an improvement in LED technology products with little or no cost increase. However, a 3.5% incremental first cost increase was assumed for the analysis. Table E-9 summarizes the incremental cost of interior lighting upgrades by building type.

Table E-9 Incremental Cost for Interior Lighting LPD change

| Prototype Building | Incremental Installed Cost, $ |
|---|---|
| Small Office | 155 |
| Medium Office | 1395 |
| Large Office | 15076 |
| Retail Standalone | 1360 |
| Hospital | 10080 |
| Large Hotel | 5075 |
| Warehouse | 108 |
| Full-Service Restaurant | 409 |

**Cost Benefit Analysis**

The interior LPD upgrade for the building area and the space-by-space methods are cost-effective, as the estimated SIR values exceeded 1.0 for the eight prototype buildings examined. In the meantime, As the cost of LED lighting devices continues to decrease, this upgrade is anticipated to become highly cost-effective. The 2023 FBC-EC and the 2024 IECC LPD values are based on the assumption of LED technology's 100% penetration. Table E-10 summarizes the net present value of energy cost savings, net investment cost, the savings-to-investment ratio for the two climate zones, and a weighted average for Florida.

Table E-10 Cost-benefit Analysis for Interior Lighting LPD Change by Building Type

| Building Type | City | Life Cycle Energy Cost Savings, $ | Investment Cost NPV, $ | SIR |
|---|---|---|---|---|
| Small Office | Miami | 353 | 148 | 2.39 |
| Small Office | Tampa | 350 | 148 | 2.37 |
| Medium Office | Miami | 2546 | 1,329 | 1.92 |
| Medium Office | Tampa | 2552 | 1,329 | 1.92 |
| Large Office | Miami | 32,734 | 14,358 | 2.28 |
| Large Office | Tampa | 28,470 | 14,358 | 1.98 |
| Stand-Alone Retail | Miami | 4,075 | 1,295 | 3.15 |
| Stand-Alone Retail | Tampa | 3,992 | 1,295 | 3.08 |
| Hospital | Miami | 68,081 | 9,600 | 7.09 |
| Hospital | Tampa | 66,906 | 9,600 | 6.97 |
| Large Hotel | Miami | 10,804 | 4,833 | 2.24 |
| Large Hotel | Tampa | 10,296 | 4,833 | 2.13 |
| Non-Refrigerated Warehouse | Miami | 369 | 103 | 3.59 |
| Non-Refrigerated Warehouse | Tampa | 325 | 103 | 3.16 |
| Full-Service Restaurant | Miami | 830 | 390 | 2.13 |
| Full-Service Restaurant | Tampa | 733 | 390 | 1.88 |
| Weighted Average | | 8972 | 2325 | 3.86 |

**Summary:** The cost-effectiveness analysis of interior lighting power density (LPD) reduction was based on a 15-year service life of LED technology for the baseline and upgrade scenarios. The first installed incremental cost was used for the analysis since the baseline and upgrade are based on 100% LED technology. The weighted average SIR value for the commercial sector across the eight prototype buildings in Florida climate estimated was about 3.86, which is cost-effective. Therefore, this code modification is recommended for addition to the 9$^{th}$ Edition (2026) Florida Building Energy Code, Energy Conservation.

**Exterior Lighting Power Allowance Reduction (CEPI-189-21)**

The 2024 IECC reduces the exterior site lighting power allowances and exterior lighting power density allowances for building facades, entrances, and parking lots per Tables C405.5.2(1) and C405.5.2(2). The base site allowance was reduced by 20% to 54%, depending on the exterior lighting zone. The exterior lighting allowance for parking lots, building entrances, and building exterior walls is also significantly reduced. The total exterior lighting allowance reduction between the 2023 FBC-EC and the 2024 IECC ranges from 23% to 34%, depending on the prototype buildings. The base site allowance was proportionally distributed among the facade, entrance, and parking lots. The exterior lighting allowances were reduced for all sixteen prototype buildings. Table E-11 provides exterior lighting allowances for the 2023 FBC-EC and the 2024 IECC by prototype buildings.

Table E-11 Exterior Lighting Allowances by Prototype Building Type

| Prototype Building | 2023 FBC-EC | | | 2024 IECC | | |
|---|---|---|---|---|---|---|
| | Building Facade, W | Building Entrance, W | Parking Lot, W | Building Facade, W | Building Entrance, W | Parking Lot, W |
| Small Office | 67 | 201 | 780 | 71 | 145 | 521 |
| Medium Office | 425 | 409 | 4,724 | 430 | 281 | 3,010 |
| Large Office | 9,973 | 992 | 26,647 | 9,932 | 922 | 17,250 |
| Retail Standalone | 270 | 1,482 | 1,989 | 274 | 1,022 | 1,271 |
| Strip Mall | 343 | 2,749 | 2,311 | 346 | 1,887 | 1,470 |
| Primary School | 132 | 1,926 | 687 | 132 | 1,348 | 447 |
| Secondary School | 356 | 3,208 | 3,178 | 359 | 2,199 | 2,018 |
| Outpatient Healthcare | 141 | 1,513 | 4,475 | 143 | 1,041 | 2,852 |
| Hospital | 2,372 | 1,614 | 5,836 | 2,358 | 1,283 | 3,687 |
| Small Hotel | 512 | 267 | 2,398 | 526 | 183 | 1,519 |
| Large Hotel | 4,007 | 474 | 6,615 | 3,978 | 376 | 4,175 |
| Warehouse | 93 | 4,308 | 1,092 | 94 | 2,958 | 695 |
| Restaurant Fast-Food | 167 | 76 | 1,099 | 167 | 59 | 701 |
| Restaurant Sit-Down | 160 | 170 | 1,846 | 161 | 132 | 1,185 |
| Mid-Rise Apartment | 214 | 0 | 1,832 | 220 | 0 | 1,187 |
| High-Rise Apartment | 2,064 | 0 | 5,517 | 2,051 | 0 | 3,486 |

**Annual Energy Savings:** Table E-12 summarizes the annual energy savings potential due to reducing exterior lighting power allowances by prototype building types, which were determined using simulations. Since the lighting reduction is on the exterior of the buildings, these energy savings do not impact the HVAC system cooling and heating operations. These energy savings are purely due to the reduction of the exterior lighting allowance.

Table E-12 Annual Energy Cost Savings for Exterior Lighting Allowance Change

| Prototype Building | City | Electric Energy Savings, kWh | Gas Energy Savings, kWh | Total Energy Savings, kWh |
|---|---|---|---|---|
| Small Office | Miami | 811 | 0 | 811 |
| Small Office | Tampa | 814 | 0 | 814 |
| Medium Office | Miami | 4,586 | 0 | 4,586 |
| Medium Office | Tampa | 4,611 | 0 | 4,611 |
| Large Office | Miami | 23,236 | 0 | 23,236 |
| Large Office | Tampa | 23,372 | 0 | 23,372 |
| Hospital | Miami | 10,903 | 0 | 10,903 |
| Hospital | Tampa | 10,889 | 0 | 10,889 |
| Small Hotel | Miami | 4,150 | 0 | 4,150 |
| Small Hotel | Tampa | 4,147 | 0 | 4,147 |
| Large Hotel | Miami | 11,219 | 0 | 11,219 |
| Large Hotel | Tampa | 11,206 | 0 | 11,206 |

**Investment Installed Cost**

Table E-13 summarizes the assumption of the exterior lighting allowance upgrade cost. The incremental cost increase assumes 100% penetration of LED technology.

Table E-13 Exterior Lighting Allowance Incremental Installed Cost

| Prototype Building | Incremental Installed Cost, $ |
|---|---|
| Small Office | 604 |
| Medium Office | 4,006 |
| Large Office | 17,004 |
| Hospital | 4,049 |
| Small Hotel | 1,651 |
| Large Hotel | 3,351 |

**Cost Benefit Analysis**

Reducing exterior lighting power allowances is cost-effective, as the estimated SIR values exceeded 1.0 for six prototype buildings examined. The 2023 FBC-EC and the 2024 IECC LPD values are based on the assumption of LED technology's 100% penetration. Table E-14 summarizes the net present value of energy cost savings, net investment cost, the savings-to-investment ratio for the two climate zones, and a weighted average for Florida. In the meantime, it is anticipated that as the cost of LED lighting devices continues to decrease, this upgrade will become highly cost-effective.

Table E-14 Cost-benefit Analysis Type for Exterior Lighting Allowance Change by Building

| Building Type | City | Life Cycle Energy Cost Savings, $ | Investment Cost NPV, $ | SIR |
|---|---|---|---|---|
| Small Office | Miami | 353 | 148 | 2.39 |
| Small Office | Tampa | 350 | 148 | 2.37 |
| Medium Office | Miami | 2,546 | 1,329 | 1.92 |
| Medium Office | Tampa | 2,552 | 1,329 | 1.92 |
| Large Office | Miami | 32,734 | 14,358 | 2.28 |
| Large Office | Tampa | 28,470 | 14,358 | 1.98 |
| Hospital | Miami | 4,075 | 1,295 | 3.15 |
| Hospital | Tampa | 3,992 | 1,295 | 3.08 |
| Small Hotel | Miami | 68,081 | 9,600 | 7.09 |
| Small Hotel | Tampa | 66,906 | 9,600 | 6.97 |
| Large Hotel | Miami | 10,804 | 4,833 | 2.24 |
| Large Hotel | Tampa | 10,296 | 4,833 | 2.13 |
| Weighted Average | | 8,318 | 4,113 | 2.02 |

**Summary:** The cost-effectiveness analysis of exterior lighting allowance reduction was based on a 15-year service life of LED technology for the baseline and the upgrade scenarios. Since the baseline and upgrade are based on 100% LED technology, the installed incremental cost was used for the analysis. The weighted average SIR value for the commercial sector across the six prototype buildings in Florida climate estimated was about 2.02, which is cost-effective. Therefore, this code modification is recommended for addition to the 9th Edition (2026) Florida Building Energy Code, Energy Conservation.

**On-Site Renewable Energy System (CED1-50-22)**

Adds a minimum prescriptive requirement for on-site renewable energy generation per Section C405.15.1. Requires that buildings must be provided with on-site renewable electricity generation systems with a power rating of not less than 0.75 W/ft$^2$ multiplied by the sum of the gross conditioned floor area of all floors, but not to exceed the combined gross conditioned floor area of the three largest floors. This requirement impacts all but the fast-food prototype building due to the floor area threshold of 5,000 ft$^2$ per one of the exceptions. Photovoltaic DC power generators were added to all prototype buildings with the minimum requirements. The PV has a DC-AC inverter and runs as a base-load generator. All the PV arrays were mounted with optimal slope, i.e., the slope matching the site latitude angle. The cost-effectiveness analysis was conducted using electric energy rates of $0.1060/kWh and $0.11890/kWh, but the results presented are based on the latter.

**Annual Energy Savings:** The modified prototype buildings' simulation for baseline represents a prototype without a PV generator, and the upgrade represents a 2024 IECC with a PV generator. Table E-15 summarizes these prototype buildings' on-site generated DC–output capacity and annual generated energy.

Table E-15 PV Peak DC-Power Output and Annual Energy Generation by Building Type

| Prototype Building | Gross Floor Area, ft$^2$ | Peak DC-Power Output, W | Miami On-site Generated Energy, kWh/yr | Tampa On-site Generated Energy, kWh/yr |
|---|---|---|---|---|
| Small Office | 5,502 | 4,127 | 5,762 | 5,915 |
| Medium Office | 53,628 | 40,221 | 56,165 | 57,654 |
| Large Office | 115,059 | 86,294 | 120,502 | 135,987 |
| Stand-Alone Retail | 24,692 | 18,519 | 25,860 | 29,183 |
| Strip Mall | 22,500 | 16,875 | 23,564 | 26,593 |
| Primary School | 73,959 | 55,469 | 77,458 | 87,411 |
| Secondary School | 210,887 | 158,165 | 220,864 | 249,246 |
| Outpatient Health Care | 40,946 | 30,710 | 42,883 | 48,394 |
| Hospital | 120,750 | 90,562 | 126,462 | 142,713 |
| Small Hotel | 30,072 | 22,554 | 31,495 | 35,542 |
| Large Hotel | 58,503 | 43,877 | 61,271 | 69,144 |
| Non-Refrigerated Warehouse | 52,045 | 39,034 | 54,507 | 61,512 |
| Quick Service Restaurant | 2,501 | | 0 | 0 |
| Full-Service Restaurant | 5,502 | 4,127 | 5,762 | 6,503 |
| Mid-Rise Apartment | 22,798 | 17,098 | 23,876 | 26,944 |
| High-Rise Apartment | 22,798 | 17,098 | 23,876 | 26,944 |

**Investment Cost:** The total installed and annual operating and maintenance costs were added as incremental costs for the on-site PV generator. The total installed cost for the rooftop PV system for 2023 based on NREL estimate[3] is $1.76/Watt of peak DC output, an annual operating and maintenance cost of $23.9/kW/Year, and the PV system has a service life span of 25 years. The service life of the inverter is assumed to be 12.5 years, and the cost of inverter replacement is $0.13 per watt of peak DC output.

**Cost-Benefit Analysis**: The cost-benefit analysis was determined using the incremental cost, service life assumptions, and annual energy cost savings determined using simulation for each prototype and an average for Florida. Table E-16 summarizes cost-effectiveness results without incentives, and Table E-17 summarizes cost-effectiveness results with incentives.

Table E-16 Cost-benefit Analysis Summary for On-Site Renewable Energy Generator without Incentive

| Prototype Building | Life Cycle Energy Cost Saving, $ | Investment Cost NPV, $ | SIR |
|---|---|---|---|
| Small Office | 8623 | 8348 | 1.03 |
| Medium Office | 88763 | 81315 | 1.09 |
| Large Office | 190443 | 174462 | 1.09 |
| Stand-Alone Retail | 41235 | 37446 | 1.10 |
| Strip Mall | 37525 | 34114 | 1.10 |
| Primary School | 123310 | 112149 | 1.10 |
| Secondary School | 345431 | 319772 | 1.08 |
| Outpatient Health Care | 68492 | 62088 | 1.10 |
| Hospital | 201598 | 183090 | 1.10 |
| Small Hotel | 50231 | 45599 | 1.10 |
| Large Hotel | 97382 | 88713 | 1.10 |
| Non-Refrigerated Warehouse | 74546 | 78919 | 0.94 |
| Quick Service Restaurant | 0 | 0 | |
| Full-Service Restaurant | 9175 | 8348 | 1.10 |
| Mid-Rise Apartment | 38018 | 34574 | 1.10 |
| High-Rise Apartment | 37623 | 34573 | 1.09 |
| Weighted Average | 81973 | 76947 | 1.07 |

**Summary:** The cost-effectiveness of the on-site renewable energy generators was investigated in all illegible prototype buildings in climate zones 1A and 2A. The average SIR across the two climate zones and fifteen prototype buildings determined without incentives ranges from 0.94 to 1.10, and the weighted average SIR across all sixteen prototype buildings is 1.07, which is cost-

[3] https://www.nrel.gov/solar/market-research-analysis/solar-installed-system-cost.html

effective. Therefore, the on-site renewable energy generation prescriptive minimum requirement (0.75 W/ft$^2$ ) without the incentives is marginally cost-effective. With incentives applied, the weighted average SIR of prototype buildings in the two climate zones ranges from 1.08 to 1.32, and the weighted average SIR of all sixteen prototype buildings is 1.26, which is cost-effective.

Table E-17 Cost-benefit Analysis Summary for On-Site Renewable Energy Generator with Incentive

| Prototype Building | Life Cycle Energy Cost Saving, $ | Investment Cost NPV, $ | SIR |
|---|---|---|---|
| Small Office | 9309 | 7657 | 1.22 |
| Medium Office | 96640 | 74588 | 1.30 |
| Large Office | 207205 | 160030 | 1.29 |
| Stand-Alone Retail | 45144 | 34349 | 1.31 |
| Strip Mall | 41042 | 31292 | 1.31 |
| Primary School | 134429 | 102873 | 1.31 |
| Secondary School | 374005 | 293321 | 1.28 |
| Outpatient Health Care | 75073 | 56952 | 1.32 |
| Hospital | 220677 | 167946 | 1.31 |
| Small Hotel | 55002 | 41827 | 1.32 |
| Large Hotel | 106376 | 81375 | 1.31 |
| Non-Refrigerated Warehouse | 78031 | 72390 | 1.08 |
| Quick Service Restaurant | 0 | 0 | |
| Full-Service Restaurant | 10035 | 7657 | 1.31 |
| Mid-Rise Apartment | 41583 | 31714 | 1.31 |
| High-Rise Apartment | 40850 | 31714 | 1.29 |
| | 88689 | 70582 | 1.26 |

This code modification is cost-effective and recommended for addition to the 9$^{th}$ Edition (2026) Florida Building Code, Energy Conservation, as stated in the 2024 IECC.