



FSEC Energy Research Center

UNIVERSITY OF CENTRAL FLORIDA

COMMERCIAL CODE REVIEW FOR THE 2023 FLORIDA BUILDING ENERGY CODE

Interim Report

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Appendix B: ASHRAE Standard 90.1-2019 Change Review Summary

Qualitative analysis of code changes is performed for every code development cycle. The qualitative analysis is performed based on code addenda published in informative appendix I of the 2019 ASHRAE Standard 90.1. Furthermore, the qualitative analysis identifies which of the code changes result in an increase or decrease in energy use. This section summarizes the code changes based on review of the addenda to ASHRAE 90.1-2016 (ASHRAE, 2016) and by reviewing the previous (ASHRAE, 2016) and current (ASHRAE, 2019) of ASHRAE Standard 90.1. The code changes addenda to the 2016 ASHRAE Standard 90.1 are provided in Table B. Table 1 summarizes the number of codes changes for each of the various sections of the code and the number of addenda items that directly impacts building energy use.

Table 1 Number of code changes addenda to ASHRAE Standard 90.1 - 2016

Section	Number of Addenda	Number of Addenda with Energy Impact
3. Definitions, Abbreviations, and Acronyms	4	-
4. Administration and Enforcement	4	-
5. Building Envelope	6	1
6. Heating Ventilation and Air Conditioning	33	20
7. Service Water Heating	1	1
8. Power	-	-
9. Lighting	10	7
10. Other Equipment	1	1
11. Energy Cost Budget Method	5	1
12. Normative References	2	-
13. Appendices A – G	22	4
Total	88	35

There are 88 code changes addenda included in ASHRAE Standard 90.1 – 2016. Of the 88 addenda, 35 were identified to have impacts on energy use. And 20 out of the 35 addenda items were identified suitable for the quantitative analysis using simulations. The 20 addenda items will be quantitatively analyzed to determine the ASHRAE 90.1-2019 code energy impact on the state of Florida.

Note that 7th Edition (2020) Florida Building Code, Energy Conservation, excludes Section 9.4.1.1(g) and Section of 8.4.2 of the 2016 ASHRAE Standard 90.1.

References:

ASHRAE 2019. ANSI/ASHRAE/IES Standard 90.1-2019 -- Energy Standard for Buildings Except Low-Rise Residential Buildings. 1791 Tullie Circle NE., Atlanta, GA 30329.

ASHRAE 2016. ASHRAE 2016. ANSI/ASHRAE/IES Standard 90.1-2016 -- Energy Standard for Buildings Except Low-Rise Residential Buildings. 1791 Tullie Circle NE., Atlanta, GA 30329.

ASHRAE Standard 90.1-2019 changes with respect to ASHRAE Standard 90.1-2016 is summarized in Table B. Table B has six columns and are defined as follows:

Addendum: is the code change addenda for the ASHRAE Standard 90.1-2019.

Code Sections Affected: proposed code change id defined in the addenda to the ASHRAE 90.1-2016. This code number is used to identify the history of the code change.

ASHRAE 90.1-2013 and ASHRAE 90.1-2016: brief description of the code change between the 2016 ASHRAE Standard 90.1 and the 2019 ASHRAE Standard 90.1.

Anticipated Energy Impact on FBC-EC if Adopted: energy use impact from the code change. This is usually a decrease energy use, an increase energy use, or none. None means the code change has no or negligible impact on energy use.

Included in quantitative Analysis: if the energy impact can be predicted using whole building simulation programs and DOE reference prototype buildings. This is “Yes” or “No”. Yes means the energy impact can be predicted using simulation, No means the impact on energy use cannot be determined using simulation.

Discussion: describes how the change impacts the implementation in the quantitative analysis, the prototype buildings are impacted and why the analysis is included or not.

Table B: Commercial Code Change Summary for ASHRAE 90.1-2016 vs. ASHRAE 90.1-2019

Addendum	Code Sections Affected	Code Change Summary Between ASHRAE 90.1-2013 and ASHRAE 90.1-2016	Anticipated Energy Impact on FBC-EC if Adopted*	Included in quantitative Analysis	Discussion
3. Definitions, Abbreviations, and Acronyms					
n	3.2	Removes ten unused definitions and changes definition of “unitary cooling equipment” to “unitary air conditioners”.	None	No	
ab	3.2	Modifies definition of “door”, “entrance door”, “fenestration”, and “sectional garage door”.	None	No	
c	3.2	Adds roof monitors to definition of fixed and operable vertical fenestration.	None	No	Modified operable and fixed vertical fenestrations definition to include roof monitor
ac	3.1, 3.2	Clarifies use of defined terms to include the term with different tense or plurality.	None	No	
4. Administration and Enforcement					
x	4.1.1.2, 4.2.1.1, 4.2.1.2, 4.2.1.3	Clarifies compliance paths for new construction, additions, and alterations.	None	No	Provides clarification to compliance paths
s	4.2.1.1, 11.4.3.1, G2.4	Modifies the Performance Cost Index (PCI) equation to implement a 5% limitation on renewable energy usage and clarifies what types of renewable energy systems are eligible.	None	No	Excluded from quantitative analysis because the prototypes are not have on-site generators
bt	Table 4.2.1.1	Revises Table 4.2.1.1 Building Performance Factor (BPF). Updates BPF in Table 4.2.1.1 for the ASHRAE 90.1-2019 code. BPF represent energy cost of the 2019 code against that of 2004 code.	None	No	Excluded from the quantitative analysis. Prototype building do not use building performance factors.
ci	Table 4.2.1.1	Further revises Table 4.2.1.1 Building Performance Factor (BPF). Updates BPF table values for the 2019 code.	None	No	Excluded from the quantitative analysis. Prototype building do not use building performance factors.

5. Building Envelope					
b	5.5.3.1.1, 12	Updates reference to ANSI/CRRC S100 “Standard Test Methods for Determining Radiative Properties of Materials”.	None	No	This is reference update hence is not included in the quantitative analysis.
q	5.4.3, 5.5, 5.8.3, 5.9.1	Clarifies and restructures air leakage requirements for the building envelope.	None	No	
ad	5.2 through 11.2	This addendum clarifies the requirements for showing compliance using the methods in Sections 5-10, or Section 11, or Appendix G.	None	No	
aw	3.2; Tables 5.5-0 through 5.5-8, 5.8.2.5, 12	Revises the fenestration prescriptive criteria in Tables 5.5-0 through 5.5-8. Fenestration classification is now material neutral and instead grouped into “fixed”, “operable”, and “entrance door” category. The SHGC is slightly stringent across all categories due to glass quality improvement but the U-factor stringency depends on the fenestration framing material and it is more stringent for metal framing products and stringency relaxed for wood framing fenestration.	Decrease	Yes	Included in the quantitative analysis. Impacts all prototype buildings.
bh	Table 5.8.3.2	Corrects an omission related to nonswinging doors in Table 5.8.3.2.	None	No	
bf	5.4.3.4; 10.4.5	Establishes an alternative to the requirement for vestibules by use of an air curtain that meets specific requirements prescribed in the proposed language. Adds new section 10.4.5. Provides design flexibility.	None	No	Excluded from the quantitative analysis. Cannot be accurately represented in the simulation model.
6. Heating, Ventilating, and Air Conditioning					
a	6.4.3.3.3, 6.3.3.4.2, 6.5.1.1.4	Changes term “ventilation air” to “outdoor air” in multiple locations. Revises tables and footnotes. Clarifies requirements for economizer return dampers. This change is clarification.	None	No	
g	3.2, 6.3.2, 6.5.3.8	Provides definition of “occupied-standby mode” and adds new ventilation air requirements for zones served in <i>occupied-standby mode</i> . Adds new definition.	Decrease	Yes	Included in the quantitative analysis. Impacts high and medium rise apartment,

		Unoccupied space doesn't need to be ventilated per standard 62.1 when spaces air temperature is within the allowed limits. Reduces ventilation air requirements to zero and setbacks cooling and heating thermostats by at least 1°F for zones served in <i>occupied-standby mode</i> . Also this changes ties the HVAC control to lighting control requirement in section 9.4.1.1.			offices, outpatient healthcare, schools prototype buildings.
h	6.5.6.1, 6.5.6.1.1	Clarifies that exhaust air energy recovery systems should be sized to meet both heating and cooling design conditions unless one mode is not exempted by existing exceptions. This change is clarification.	None	No	Excluded from quantitative analysis. The prototype buildings energy recovery already meets this requirement.
j	6.4.3.8	Changes an exception related to demand control ventilation to clarify the intent.	None	No	This change may not impact the prototype buildings hence not included in the quantitative analysis.
k	3.2, 6.4.3.3.5	Revises definition of "networked guest room control system" and aligns HVAC and lighting timeout periods for guest rooms. Reduces the HVAC timeout period from 30 to 20 minutes to match the 20 minutes timeout period for lighting control.	Decrease	Yes	Included in the quantitative analysis. Impacts prototype buildings small and large hotels.
p	Table 6.1.8 - 14	Revises the rating conditions for indoor pool dehumidifiers.	None	No	
o	3.2, 4.2.2.3, 5.5, 5.7 through 11.7, G 1.3	Revises the submittals section of the envelope and power chapters for consistency across the standard.	None	No	
v	6.5.6.3	Adds section 6.5.6.3 containing heat recovery requirements for space conditioning in acute inpatient hospitals. Adds new sub-section. Heat recovery chillers are required in acute inpatient hospitals where: the building operates 24 hours, the chilled water system rated capacity is greater than 300 tons, uses simultaneous heat and cool above 60F, and	Decrease	Yes	Included in the quantitative analysis. Impacts hospital prototype building.

		the heat recovery chiller cooling capacity is greater than 7% of chilled water system rated design capacity. This section has exception depending on on-site recovered or generated energy and climate zones.			
ae	3.2, 6.4.3.6, G3.1.3.18	Clarify humidification and dehumidification control requirements.	None	No	This change is a clarification.
ai	3.2, 4.2.5, 5.2.9, 6.7.2.4, 9.4.3, 5.9 through 10.9, 11.2	Restructures commissioning and functional testing requirements in all sections of Standard 90.1 to require verification for smaller and simpler buildings and commissioning for larger and more complex buildings. This change is a clarification.	None	No	
aj	3.2, 6.5.1, 6.5.2.3, 6.5.4.4	Adds a new definition “process application” and uses it throughout Standard in place of “process load”.	None	No	
am	6.5.6.4	Adds an indoor pool dehumidifier energy recovery requirement in new section 6.5.6.4. Requires 50% energy recovery efficiency for indoor pool dehumidifier energy recovery.	Decrease	No	Excluded from the quantitative analysis because the prototype building do not have indoor pool.
ao	3.2; 6.5.3.1.3;	Introduces the revised fan product efficiency requirement Fan Energy Index (FEI) and complements the fan power limitation in section 6.5.3.1.1. FEI is DOE’s new fan efficiency metrics that better represents fan energy use performance.	Decrease	No	
ap	6.5.3.5	Revises supply air temperature reset controls. Applies supply air temperature reset strategy. This code change will bring up to 5°F supply temperature difference decrease depending on outdoor air temperature or load. This code requirement has exemption depending on climate zone and system design outdoor air flow rate.	Decrease	Yes	Included in the quantitative analysis. Impacts prototype buildings: large office, large hotel, hospital, outpatient healthcare, and schools.
au	6.5.2.1	Eliminates the requirement that zones with DDC have air flow rates that are no more than 20% of the zone design peak flow rate.	Decrease	Yes	Included in the quantitative analysis. Impacts prototype buildings: Medium Office, Large Office, Primary School, Secondary School,

		zone reheated air flow rate can be ventilation requirement per ASHRAE Std 62.1 instead of 20% of the peak flow rate.			OutPatient Health Care, and Large Hotel.
ay	3.2, 6.5.6	Provides separate requirements for nontransient dwelling unit exhaust air energy recovery. New section 6.5.6.1.1 Nontransient Dwelling Units. Requires exhaust energy recovery at least 50% efficiency for cooling and 60% for heating for non-transient dwelling units (apartments and condos 4 story and higher).	Decrease	Yes	Included in the quantitative analysis. Impacts the Nontransient Dwelling Units are in High and Medium Rise Apartment prototype buildings.
bd	Table 6.8.1-16	Adds the minimum efficiency requirements of Heat Pump and Heat Reclaim Chiller Packages. Adds minimum efficiency requirement for Heat Pump and Heat Reclaim Chiller Packages as a new HVAC equipment category.	Decrease	Yes	Included in the quantitative analysis. Impacts hospital prototype building.
be	6.4.1.1; Table 6.8.1-10, 6.8.1-17	Revises the minimum efficiency requirements for Computer Room air conditioners. Upgrades the minimum efficiency requirement based on federal minimum efficiency.	Decrease	Yes	Included in the quantitative analysis all prototype buildings as needed.
bj	6.5.5.1	Adds tables to the list of products that are exempt from meeting the requirements of section 6.5.6 - Heat Rejection Equipment. Updates heat-rejection devices that are exempted from the requirements of section 6.5.6.	None	No	
bl	Table 6.8.1-1	Revises Table 6.8.1-1 Electrically Operated Unitary Air Conditioners and Condensing Units—Minimum Efficiency Requirements. Upgrades the minimum efficiency requirement based on federal minimum efficiency.	Decrease	Yes	Included in the quantitative analysis all prototype buildings as needed.
bm	Table 6.8.1-2, 6.8.1-15	Revises Table 6.8.1-2 Electrically Operated Air Cooled Unitary Heat Pumps—Minimum Efficiency Requirements. Adds Table 6.8.1-15.	Decrease	Yes	Included in the quantitative analysis all prototype buildings as needed.

		Upgrades the minimum efficiency requirement based on federal minimum efficiency.			
bn	3.2, Table 6.8.1-4, Table F3	Revises Table 6.8.1-4 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. Adds Table F-3. Upgrades the minimum efficiency requirement based on federal minimum efficiency.	Decrease	Yes	Included in the quantitative analysis all prototype buildings as needed.
bo	3; Table 6.8.1- 5; Table F-4	Revises Table 6.8.1-5 Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters—Minimum Efficiency Requirements and adds Table F-4 Residential Warm Air Furnaces – Minimum Efficiency Requirements for sale in the US. (see 10 CFR Part 430). Upgrades the minimum efficiency requirement based on federal minimum efficiency.	Decrease	Yes	Included in the quantitative analysis. Impacts prototype buildings with this equipment depending the capacity.
bp	Table 6.8.1-6; Table F-5	Revises Table 6.8.1.6 – Gas and Oil-Fired Boilers – Minimum Efficiency Requirements and adds table F-5 - Residential Boiler Minimum Efficiency Requirements for applications in the US (Refer to 10 CFR 430). Upgrades the minimum efficiency requirement based on federal minimum efficiency.	Decrease	Yes	Included in the quantitative analysis all prototype buildings as needed.
bq	Table 6.8.1-7; 12	Revises Table 6.8.1-7 Performance Requirements for Heat Rejection Equipment—Minimum Efficiency Requirements. Upgrades the minimum efficiency requirement of some of the heat rejection equipment category based on federal minimum efficiency.	Decrease	Yes	Included in the quantitative analysis all prototype buildings as needed.
br	Table 6.8.1-11	Revises the previous Tables 6.8.1-12 & 13 and combines them into one table - Table 6.8.1-11	Decrease	Yes	Included in the quantitative analysis all prototype buildings as needed.

		Commercial Refrigerators, Commercial Freezers and Refrigeration—Minimum Efficiency Requirements. <i>Updates the efficiencies levels.</i>			
bv	6.2.1, 6.6.2, 8.2.1, 8.6.1	Clarifies that designers have the option to use ASHRAE Standard 90.4 requirements instead of ASHRAE 90.1 requirements in computer rooms that have an IT equipment load larger than 10 kW. Section 8.6.1 requires to comply with ASHRAE Standard 90.4 and is applicable. The new section: adds new definition for computer room that meets >10W/ft ² and > 10 kW electric, or IT equipment load, suitable for big data centers, and has more stringent electric efficiency requirement.	Decrease	No	Excluded from quantitative analysis because computer rooms in the prototype buildings do not meet this criteria.
ce	6.5.3.1.2	Makes revisions to provide energy savings potential by removing one of three criteria for fan motor selections, increasing the design options for load matching variable-speed fan applications, accommodating new motor and drive technologies, and simplifies the motor selection criteria for fans. This code change impacts fan design and selection, and provides better metric for fan energy savings.	Decrease	No	
cf	6.4.5	Adds vacuum insulating glazing to the list of options for reach-in doors in walk-in coolers and freezers. Provides design flexibility.	Decrease	No	Excluded from quantitative analysis.
cm	6.5.2.1	Revises exceptions related to DDC enabled zones. Removes the exception 2(a), which exempts when the minimum supply air flow rate is less than 25% of the peak design flow rate. This code change is makes the section consistent with addenda “ao”.	None	No	
cn	6.4, 6.4.1.1, 6.4.5m Tables 6.8.1-18,19, & 20.	Cleans up outdated language regarding walk-in cooler and walk-in freezer requirements, and make the requirements consistent with current federal regulations that either already came into effect June 5, 2017 or will come into effect July 10, 2020. Adds new section 6.4.5(m) and Tables 6.8.1-18, -19, and -20.	None	No	This change is clarification.

		Makes the code consistent with federal minimum requirements.			
cq	3.2; 6.4.1.2, 6.5.3.1.3	Makes clarifications ensure that the maximum fan power input is properly reported for installations both inside and outside the United States. Adds sections 6.4.1.3 and 6.5.3.1.3. Adds fan power reporting requirement for ceiling fans larger than 84.5 inch in diameter.	None	No	
cu	6.4.1.1, 6.4.1.5, Table 6.8.1-8	Revises requirements for liquid-to-liquid heat exchangers. This is informative change.	None	No	Excluded from the quantitative analysis. Efficiency upgrade are already accounted by other changes.
7. Service Water Heating					
bs	Table 7.8; F2; Table F-2	Revises Table 7.8 Performance Requirements for Water-Heating Equipment—Minimum Efficiency Requirements and Table F-2 Minimum Energy Efficiency Requirements for Water Heaters.	Decrease	No	Excluded from the quantitative analysis. Prototype buildings are not impacted by the selected equipment efficiency upgrade.
8. Power					
9. Lighting					
bg (formerly addendum bg to 90.1-2013)	9.2, 9.3 9.3.1, 9.3.2 Tables 9.3.1-1, 9.3.1-2, 9.3.1-3, and 9.3.2	Added new Simplified Building Method Compliance Path for interior lights in offices, schools, or retail buildings, and exterior lights. This is simpler and faster lighting compliance method applicable when at least 80% of floor area is used for office, school, or retail buildings. The method is used in new construction, additions, or alterations with floor area less than 25,000 ft ² . Interior and exterior wattage allowances shall be calculated and complied	Decrease	No	Provides flexibility for designers but will not impact the prototype buildings. Excluded from quantitative analysis because the exceptions are not used by typical designs as represented by the prototypes.

		with separately. All interior lights are counted. The LPD is lower than that of the space-by-space method.			
t	9.4.2, Table 9.4.2-2	Expands the exterior LPD application table to cover additional exterior spaces that are not currently in the exterior LPD table. None typical exterior lighting area applications that are not listed in Table 9.4.2 can be covered by this change. Interior LPDs from Table 9.4.1 are reduced and applied to exterior lighting application that are not listed in Table 9.4.2.	Decrease	No	Excluded from the quantitative analysis. Prototype buildings do not have none-typical exterior lighting application.
ah	9.1.4	Updates the language and terminology of the lighting wattage section. Also adds a section specifically to address using DC power over Cat6 structured cable for connection of LED lighting to a remote power supply. Replaced “luminaire” with “lighting equipment” and “ballast” with “ballast/Driver” to accommodate latest lighting technologies.	None	No	This change is a clarification.
aq	9.1.1, 9.2.2.3, 9.4.1.1, 9.4.1.3, 9.4.4, 9.6.2	Clarifies lighting control requirements for applications not covered in Section 9.6.2, the space-by-space method. Clarifies the lighting control requirements for lighting (special) applications not specifically covered in Table 9.6.1 and aligns them to mandatory control provisions in 9.4.1.	None	No	This is clarification. Needs prototype building models specification check.
bb	Table 9.6.1	Revises the lighting power densities for the Space-by-Space method. The space-by-space method LPDs on average were reduced by 5.0% from 2016 version. Lobby/Hotel reduced from 1.06 to 0.51 Guestroom reduced from 0.77 to 0.41 Class room reduced from .92 to 0.71 Parking area, interior increased from 0.14 to 0.15.	Decrease	Yes	Included in the quantitative analysis all prototype buildings as needed.
cg	Table 9.5.1	Revises Table 9.5.1 Lighting Power Density Allowances Using the Building Area Method.	Decrease	Yes	Included in the quantitative analysis depending on the prototype buildings. Impacts

		The building area method LPDs on average were reduced by 5.0% from 2016 version. Office reduced from 0.79 to 0.64 Hotel/Motel reduced from 0.75 to 0.56 Retail reduced from 1.06 to 0.84 Warehouse reduced from 0.48 to 0.45.			the three office and warehouse prototype buildings.
cv	9.4.1.2	Updates lighting control requirements for parking garages in section 9.4.1.2. Increases the stringency of lighting control in parking garages: <ul style="list-style-type: none"> Reduces lighting power input from 30% to 50% when no activity Reduces the timeout period from 20 to 10 minutes Continuous daylight dimming down to 50% for luminaires within 20ft of wall opening. 	Decrease	No	Excluded from quantitative analysis because the prototype buildings do not have parking garage.
cw	9.4.1.1(e), 9.4.1.1(f)	Revises the daylight responsiveness requirements to continuous dimming for sidelight and toplight daylighting controls by (1) eliminating step dimming, (2) using continuous dimming limit set to 20% or less, or off, and (3) controlling daylights to unoccupied setpoint when needed.	Decrease	Yes	Included in the quantitative analysis. All prototype buildings with daylighting control such as small, medium and large offices, schools, etc.
cy	9.4.1(e)	Revises daylighting for sidelighting requirements: <ul style="list-style-type: none"> Modifies a text such that setback distance is horizontal measurement. Adds natural object as an obstruction Removes erroneous statement 	None	No	Excluded from the quantitative analysis since this not a typical design and none of the prototype buildings has such design feature.
ch	3.2; 9.4.1.1 (e)	Clarifies daylighted area requirements as they relate to skylights and clarifies requirements for primary sidelighted areas. This code change applies to daylight area calculation under skylights in multi-story spaces. Also adds an exemption for primary sidelight areas adjacent to vertical fenestrations that have external projections and no vertical fenestration above the external projection.	Decrease	No	Excluded from the quantitative analysis since this not a typical design and none of the prototype buildings has such design feature.

10. Other Equipment					
an	3.2, 10.4.7, Table 10.8-6; 12; Appendix E	Provides a new table (Table 10.8-6) of information about the new efficiency requirements for commercial and industrial clean water pumps. It also provides new definitions that are needed to accompany the table. Adds new section 10.4.7 and defines Pump Efficiency Index (PEI).	Decrease	No	Excluded from the quantitative analysis. This is not included in the prototype buildings design.
11. Energy Cost Budget Method					
at	11.5.1; G1.2.2	Revises language for energy accounting at buildings that provide fuel or electricity to vehicles. Energy used for recharging or refueling vehicles used off-site is not counted when calculating proposed building energy cost.	None	No	Excluded from the quantitative analysis since the prototype buildings do not use vehicles on-site.
bi	11.4.2; 12; Appendix C; Appendix G	Updates the reference year for Standard 140 in Sections 11 and 12 as well as Appendix C and G. Adds new requirements for software that support ECB and Appendix G compliance method: <ul style="list-style-type: none"> • Post Standard 140 results on public website alongside results from reference software • Complete standard 140 reports for falling outside the reference results • Provide link with modeled submittals 	None	No	
bk	3.2, 11.4.3.2, G2.4.2	Clarifies that such projects must model the same electricity generation system in the baseline and proposed design and aligns with the interpretation IC 90.1- 2013-16 of ANSI/ASHRAE/IES STANDARD 90.1-2013 from January 21, 2018. If the proposed building has on-site electric generation (e.g., CHP or Fuel Cell), then the baseline must include the same generation system, but no recovered heat.	Decrease	No	Excluded from the quantitative analysis because the prototype buildings do not include on-site electric generators.

cj	Table 11.5.1.6; Table G3.1.6; Table G3.7	Revises the energy cost budget method in reference to lighting.	No	No	Excluded from the quantitative analysis.
cl	3.2; 11; Appendix G	Clarifies requirements throughout Section 11 to better align with Appendix G providing greater consistency between the two sections.	None	No	This change is clarification only.
12. Normative References					
co	12	Revises the normative references in ASHRAE Standard 90.1.	None	No	
ct	12	Updates the CTI normative reference in ASHRAE Standard 90.1.	None	No	
Appendix: A through G, and I					
dn (formerly addendum dn to 90.1-2013)	A9.4	Allows the use of the R-value of an airspace in enclosed cavities with or without insulation. Expands the R-value table in Appendix A (based on 2009 ASHRAE Handbook—Fundamentals, Chapter 26).	None	No	Accounts for R-value of airspace in the Assembly R-value calculation but the prototype buildings are created based on U-factor. Excluded from quantitative analysis because the prototype buildings are not impacted by this change.
bx	3.2, A6.1, A6.3	Adds heated slab F-factors for multiple combinations of under-slab and perimeter insulation in Appendix A. Adds Table A6.3.1-1 and Table A6.3.1-2.	Decrease	No	Excluded from the quantitative analysis because they are modeled in the prototype buildings in Florida climate. Needs check.
bz	3.2; Appendix C1.4, C2, C3.1.2, C3.3, C3.5.5.1, C3.5.8	Clarifies requirements of Appendix C as they pertain to informative outputs, the schedule of shades, energy costs, and updates references to Section 6.	None	No	This change is clarification.
ca	Table A3.2.3	Adds U-factors to Table A3.2.3 for use of continuous insulation on metal building walls with double layer cavity insulation.	None	No	Provided design flexibility. Needs further checks.

cc	A9.4.6	Clarifies the limitations of the calculation procedures in A9.4.6.	None	No	Provided clarification.
cs	Appendix E	Revises the informative references of the Informative Appendix E.	None	No	
as	Appendix I	Adds an informative appendix specific to commissioning	None	No	
d	Table G3.1.1	Modifies text to make it consistent with other portions of Appendix G for projects undergoing phased permitting. Not yet designed building components are modeled to comply with current prescriptive requirements such that future commitments are not rewarded or penalized.	None	No	Modified text for consistency with other sections. Not included in the quantitative analysis.
e	Table G3.1-11	Adds direction that SWH piping losses shall not be modeled for baseline and proposed building in cost budget compliance method. Pipe insulation is mandatory so, pipe loss modeling is not required. Also when a proposed design includes combined space and service water heating system, then the baseline system must use two separate systems.	None	No	SWH piping losses must not be modeled for both proposed and budget design buildings. Excluded from the quantitative analysis. Needs check.
f	G3.1.2.1	Modified text to require that the capacity used for selecting the system efficiency represents that for the size of the actual zone instead of the size of the zones as combined into a single thermal block. Clarifies that individual zones capacity should determine the equipment efficiency instead of combined zones (block) capacity. This reduced capacity results in small equipment which in turn yields higher efficiency.	Decrease	No	This is modeling practice clarification hence not necessarily impact the quantitative analysis. The prototype buildings are based on predefined thermal zones.
l	Table G3.1.2.9	Adds requirements for fan break horsepower for two systems (baseline HVAC systems 12 and 13). Fixes an oversight where baseline fan power was not prescribed for system 12 and 13.	None	No	May not impact the prototype buildings hence not included in the quantitative analysis

m	Table G3.1.5	<p>Lowens baseline building performance air leakage and sets an air leakage value to be used in conjunction with the air-barrier verification path.</p> <p>Prescribe infiltration rate of 0.6 cfm/ft² for proposed building if prescriptive air barrier requirement is met and 1.0 cfm/ft² for the baseline building. Previously the infiltration rate was 0.4 cfm/ft² for proposed and baseline buildings design.</p>	None	No	Excluded from the quantitative analysis. Prototype buildings already exceeds this specification.
r	G3.1.2.6	<p>Specifies air economizer control types for Appendix G.</p> <p>Clarifies that the baseline economizer must be simulated as integrated with the mechanical cooling.</p>	None	No	This change is clarification hence not included in the quantitative analysis.
y	G3.1.2.2	<p>Fixes duct sizing run parameters within the Appendix G.</p> <p>Clarifies that the baseline oversizing applies only to the heating and cooling capacity, not to the air flow rate.</p>	None	No	May impact the sizing runs of prototype buildings. Verify methods and schedules of prototype buildings.
z	G3.1.2.1, Table G3.5.1, Table G3.5.2	<p>Modifies the formulas in Section 11 and G3.1.2.1 for removing fan energy from baseline packaged heating and cooling efficiency ratings to cap the system capacity equations in Section 11 to levels allowed in Section 6 and provide a fixed baseline efficiency rating for Appendix G.</p> <p>ECB method has an updated baseline no-fan COP calculation formula, which the capacity is capped at 63 ton, for packaged system. Whereas appendix G uses a fixed COP value.</p>	None	No	Not included in the quantitative analysis. Does not impact the prototype buildings.
ag	Table G3.1-12	<p>Provides accounts for the inclusion of automatic receptacle controls in a proposed building.</p> <p>Provides a methodology for receiving credits for installing automatic receptacle control when not required.</p>	None	No	This change is a clarification.

ak	Table G3.1.5, Tables G3.4-1 through G3.4-8	Defines SHGC baseline for buildings in zones where there is no prescriptive maximum SHGC. Provides baseline fenestration default SHGC and VT values as a simplification, instead of referring the users to appendix C.	None	No	Excluded in the quantitative analysis. This is already accounted for using addenda “aw”.
al	Table G3.1.3, Table G3.1.7	Clarifies the modeling rules within section G3.1. <ul style="list-style-type: none"> • How thermal zones are combined • Replaced “spaces” with “HVAC zones” • Requires to use space-by-space method for lighting compliance calculation when the space type is known; otherwise, allows to use building area method. 	Decrease	No	
ar	Table G3.1.12, G3.1.2.9, Table G 3.5.5, Table G.3.5.6, Table G3.6, Table G3.9.1	Cleanup of motor requirements in Appendix G related to Addenda di in Standard 90.1-2016. Tables minor edits, language cleanup and editorial changes.	None	No	
az	Table G3.1-17	Revises the modeling methodology language to clarify the baseline and proposed designs for refrigeration equipment. Specifies that the proposed building refrigeration system rated in accordance with AHRI 1200 should be modeled with the rated energy use.	None	No	May be included in the quantitative analysis if there is refrigeration equipment in the prototype buildings. Check Hotels, hospitals, restaurants, and school buildings models and verify with the new requirement.
ba	Table G3.1-1 Table G3.1-11	Establishes a methodology for determining the baseline flow rates on projects where service water-heating is demonstrated to be reduced by water conservation measures that reduce the physical volume of service water required. Establishes how the baseline is determined when allowed to differ from the proposed design but the	Decrease	No	Not included in the quantitative analysis. This feature is may be considered beyond code buildings design.

		<p>baseline values are unspecified (SWH load, cooking equipment, laboratory equipment, etc):</p> <ul style="list-style-type: none"> • Use the prescriptive requirement • Use other applicable standards 			
bu	<p>Table G3.1.1-1, G3.1.1, G3.1.3, Table G3.4-1 through Table G3.4-8</p>	<p>Clarifies requirements in the Appendix G as they related to HVAC zones and baseline heating.</p> <p>Various editorial changes:</p> <ul style="list-style-type: none"> • Removed leftover references • Replaced “space” with “zones” • Replaced “process loads” with “internal loads” 	None	No	This is clarification.

* FSEC assessment of energy impacts consistent with those in the addenda to the 2016 ASHRAE 90.1 unless otherwise noted.