

## ASHRAE Standard 90.1-2016 Code Change Review Summary

Department of Energy (DOE) provides a qualitative and quantitative analysis of impacts of code changes for every code development cycle. The qualitative analysis determines code change addenda applicable to prescriptive and performance code compliance methods that has direct impact on energy use. Furthermore, the qualitative analysis identifies which of the code changes result in an increase or decrease in energy use. This section is summary of the qualitative analysis extracted from the Energy Savings Analysis report for ASHRAE Standard 90.1-2016 (US DOE, 2017).

Summary of code changes addenda included in ASHRAE Standard 90.1-2016 are provided in Table 2. This table summarizes the number of codes changes for each of the various sections of the code and the number of addenda items that directly impact building energy use.

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

Section	Number of Addenda	Number of Addenda with Energy Impact
5. Building Envelope	19	9
6. Heating Ventilation and Air Conditioning	43	26
7. Service Water Heating	4	1
8. Power	2	1
9. Lighting	18	11
10. Other Equipment	3	1
11. Appendices C and G	29	1
12. Normative References	1	1
Various	2	0
Total	121	51

There are 121 code changes addenda included in ASHRAE Standard 90.1 – 2016. Of the 121 code changes addenda, 51 addenda items were identified to have impacts on energy use. And 21 out of the 51 addenda items were identified suitable for the quantitative analysis using simulations (US DOE, 2017). The code change addenda that has energy impacts are provided in Table 2. The 21 addenda items will be quantitatively analyzed to determine the ASHRAE 90.1-2016 code energy impact on the state of Florida.

### References:

US DOE 2017. Energy Savings Analysis: ANSI/ASHRAE/IES Standard 90.1-2016. US Department of Energy. Office Energy Efficiency and Renewable Energy. Report. October 2017. [https://www.energycodes.gov/sites/default/files/documents/02222018\\_Standard\\_90.1-2016\\_Determination\\_TSD.pdf](https://www.energycodes.gov/sites/default/files/documents/02222018_Standard_90.1-2016_Determination_TSD.pdf). Accessed February, 2018.

Table 2 Commercial Code Change Summary for ASHRAE 90.1- 2016

Addendum	Code Sections Affected	Code Change Summary Between ASHRAE 90.1-2013 and ASHRAE 90.1-2016	Impact on Energy Use	Included in quantitative Analysis	Discussion
a	3.2, 5.1.2.1	Modifies the definition of conditioned space and modifies the heated space criteria table	Decreases Energy Use	No	Lowers the threshold for spaces to be considered heated resulting in a requirement for additional insulation. Excluded from quantitative analysis because the prototype space classifications are held constant from one edition of the standard to the next.
d	6.3.2, 6.4.3.3	Requires deeper thermostat setback for networked guestrooms or those unoccupied for more than 16 hours/day. Also requires ventilation to be turned off when guestrooms are unoccupied.	Decreases Energy Use	Yes	Increases stringency of hotel/motel guest room control.
e	9.1.2	Increases requirements for alterations to existing building lighting systems.	Decreases Energy Use	No	Excluded from quantitative analysis because the analysis considers new construction only and this applies only to existing buildings.
f	9.4.1.1	Changes an exception to the automatic daylight control requirements for daylight areas under skylights from visible transmittance to effective aperture.	Decreases Energy Use	No	Changes an exception that increases stringency. Excluded from quantitative analysis because typical designs as represented by the prototypes do not qualify for the exception.
i	6.5.1	Eliminates separate cooling capacity thresholds for requiring an economizer in computer rooms. Computer rooms will be required to follow the same thresholds as comfort cooling applications.	Decreases Energy Use	Yes	Smaller computer rooms will now need economizers.
j	6.5.3.3	Requires variable air volume (VAV) system ventilation optimization even when energy recovery ventilator (ERV) is installed.	Decreases Energy Use	Yes	Removes the ventilation optimization exception for ERV, making the requirement more stringent.
l	4.2.4, 4.2.5, 5.2.1, 5.2.9 (new section)	Adds verification requirements for envelope components, including insulation, fenestration, doors, and air leakage.	Decreases Energy Use	No	Excluded from quantitative analysis because the analysis does not take credit for verification or commissioning.

Table 2 Commercial Code Change Summary for ASHRAE 90.1- 2016 (continued)

Addendum	Code Sections Affected	Code Change Summary Between ASHRAE 90.1-2013 and ASHRAE 90.1-2016	Impact on Energy Use	Included in quantitative Analysis	Discussion
n	Tables 6.8.1-9, 6.8.1-10	Modifies integrated energy efficiency ratio (IEER) values for air-cooled variable refrigerant flow (VRF) air conditioners and heat pumps above 65,000 Btu/h. The new IEERs are between 15% and 20% more stringent.	Decreases Energy Use	No	Excluded from quantitative analysis because typical designs, as represented by the established prototypes, do not include VRF systems.
q	Table 6.5.3.1-2	Allows only the following systems to use the fan power allowance for fully ducted return and/or exhaust systems: (1) systems required to be fully ducted by code or accredited standards; (2) systems required to maintain air pressure differentials between adjacent rooms.	Decreases Energy Use	No	Reduces fan energy through improved efficiency in other components in designs that utilize ducted return or exhaust by choice. Excluded from quantitative analysis because typical designs as represented by prototypes do not utilize this extra return or exhaust duct credit.
s	6.5.2.1	Relieves parallel fan powered box and dedicated outdoor air system (DOAS) with direct digital control (DDC) from requirements c & d in exception 2 of Section 6.5.2.1.	Decreases Energy Use	No	Increases energy use because it allows some designs to avoid a requirement for two stages of heating. Excluded from quantitative analysis because typical designs as represented by the prototypes do not include perimeter heating or parallel fan-powered terminal units.
u	6.5.7	Applies transfer air requirements more broadly than to just kitchen exhaust systems, and clarifies the sources of transfer air.	Decreases Energy Use	Yes	Makes transfer air requirements more stringent.
v	5.5.4.5	Deletes exception 2 of the fenestration orientation requirement for obstructions to south-facing glazing.	Decreases Energy Use	No	Deletes the exception increasing stringency. Excluded from quantitative analysis because obstructions are not modeled in the prototypes.
w	Multiple, Chapters 3, 4, 5, 6, 9, 12, Appendices A, B, D, E, G, Reference Standard Reproduction Annex (new)	Refers 90.1 to new climatic data based on Standard 169-2013 resulting in changes to climate zone assignments for some locations, the creation of a new climate zone 0, and the addition of criteria for climate zone 0. Adds method for rating the solar reflectance index of walls with glass spandrel area and adjusts criteria for minimum skylight area in climate zone 0.	Increases Energy Use	Yes	This change indirectly affects how climate zones are defined and applied through Standard 90.1. For example, the recent update shifted a relatively small number of locations to warmer climate zones where they were typically subject to less stringent requirements, therefore increasing energy use in those instances. Impacts some counties in south Florida.

Table 2 Commercial Code Change Summary for ASHRAE 90.1- 2016 (continued)

Addendum	Code Sections Affected	Code Change Summary Between ASHRAE 90.1-2013 and ASHRAE 90.1-2016	Impact on Energy Use	Included in quantitative Analysis	Discussion
ac	A9.4	Allows the use of the R-value of an airspace in enclosed cavities with or without insulation (Appendix A). Expands the R-value table in Appendix A (based on Chapter 26 of the 2009 Handbook of Fundamentals).	Decreases Energy Use	No	Sets criteria limiting when the R-value of air spaces may be included in calculations. Excluded from quantitative analysis because it did not change opaque envelope U-factors if assemblies modeled in the prototypes.
ag	6.4.3.9	Limits mechanical cooling to 85°F for vestibules, except when the vestibule is tempered with transfer air or heated with recovered energy.	Decreases Energy Use	No	Limits cooling setpoint in vestibules. Excluded from quantitative analysis because typical designs as represented by the prototypes do not include vestibules with cooling.
ah	9.4.1.1	Clarifies that all lighting, including egress lighting on emergency circuits, shall be turned off when the space is unoccupied with 0.02 W/sf in exception.	Decreases Energy Use	Yes	Increases application of controls for emergency lighting.
ai	5.5.4.1, Tables 5.5-0 through 5.5-8	Prescribes lower solar heat gain coefficient (SHGC) for vertical fenestration in climate zone 0 and lower U-factors for vertical fenestration in climate zones 4 through 8.	Decreases Energy Use	Yes	Requires more stringent window U-factor and SHGC.
aj	6.5.3.2.1, 6.5.3.2.4	Requires return and relief fans larger than 0.5 hp to have variable frequency drive (VFD) control, to maintain building pressure, and to avoid disabling of economizer operation.	Decreases Energy Use	No	Ensures proper pressurization that allows economizers to function more efficiently. Excluded from quantitative analysis because return and relief fans are not explicitly modeled in the prototypes.
ak	6.5.4.1, 6.5.4.3	Addresses a number of issues with hydronic section (6.5.4.1) including removal of the pump power threshold, limiting Section 6.5.4.1 to heating and cooling hydronic systems only, lowering the flow limit exception, and other changes.	Decreases Energy Use	No	Increases application of variable flow hydronic systems and reduces the required minimum flow. Excluded from quantitative analysis because the requirement is standard practice that was already assumed in the prototypes.
al	5.4.3.2	Prescribes air leakage criteria for metal coiling doors in semi-heated spaces.	Decreases Energy Use	Yes	Adds coiling door air leakage requirements.

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Addendum	Code Sections Affected	Code Change Summary Between ASHRAE 90.1-2013 and ASHRAE 90.1-2016	Impact on Energy Use	Included in quantitative Analysis	Discussion
am	9.4.1.2	Increases the parking garage lighting reduction from 30% to 50% in response to no occupancy, specifies a 50% reduction in lighting power in response to the presence of daylighting, and removes a duplicate exception.	Decreases Energy Use	No	Excluded from quantitative analysis because the prototypes do not include parking garages.
as	9.4.1.4	Requires luminaires in parking areas with input power greater than 78W and mounting height less than 24 ft to reduce power by 50% in response to occupancy.	Decreases Energy Use	Yes	Adds parking lot occupancy controls, thereby reducing parking lot lighting use.
aw	6.5.61	Clarifies and limits the exceptions to exhaust air energy recovery requirements (6.5.6.1).	Decreases Energy Use	No	Excluded from quantitative analysis because the exceptions are not used by typical designs as represented by the prototypes.
ay	5.4.3.1.3	Allows non-adhered single-ply roof membranes to qualify as an air barrier material.	Increases Energy Use	No	Increases energy use because it potentially increases heat loss through fluttering. Excluded from quantitative analysis because single-ply non-adhered roofing membranes are not included in the prototypes.
bc	Tables 5.5.0 through 5.5.8	Lowers U-factor criteria for doors.	Decreases Energy Use	Yes	
bi	6.5.2.6	Limits ventilation air heating (DOAS systems).	Decreases Energy Use	No	Limits simultaneous heating and cooling. Excluded from quantitative analysis because the DOAS system in the Large Hotel prototype already meets this requirement.
bj	6.5.4.7	Establishes minimum chilled water coil selection delta T.	Decreases Energy Use	Yes	Reduces pumping energy.
bk	6.5.3.4	Specifies control of fans in fan powered parallel VAV boxes	Decreases Energy Use	No	Includes several control strategies that reduce energy use in fan powered terminal units. Excluded from quantitative analysis because typical design as represented by the prototypes does not employ parallel fan-powered terminal units.

Table 2 Commercial Code Change Summary for ASHRAE 90.1- 2016 (continued)

Addendum	Code Sections Affected	Code Change Summary Between ASHRAE 90.1-2013 and ASHRAE 90.1-2016	Impact on Energy Use	Included in quantitative Analysis	Discussion
bn	6.3.2, 6.5.3.6	Sets maximum outdoor air ventilation design requirements for heat recovery.	Decreases Energy Use	No	Limits outdoor air ventilation, or requires mitigation to make up for increased ventilation. Excluded from quantitative analysis because prototype OA is set at ASHRAE Standard 62.1 limits and is already below the maximum.
bs	Table 6.8.1-10	Increases water-cooled VRF efficiencies.	Decreases Energy Use	No	Excluded from quantitative analysis because typical designs as represented by the prototypes do not include VRF systems.
bt	Table 8.4.4	Updates transformer efficiency requirements.	Decreases Energy Use	No	Excluded from quantitative analysis because transformers are a federally-regulated product.
by	7.4.3	Requires insulation of the first 8 ft of branch piping from recirculating SWH systems.	Decreases Energy Use	Yes	Reduces heat loss from SWH branch piping.
ca	6.5.2.2.1	Reduces the threshold for variable flow heat rejection device fans from 7.5 to 5 hp. Eliminates the exception for climate zones 1 and 2.	Decreases Energy Use	Yes	
cb	6.4.4.1.2, Tables 6.8.2-1, 6.8.2-2, 6.8.2	Increases ductwork insulation requirements.	Decreases Energy Use	No	Increases required duct insulation. Excluded from quantitative analysis because duct heat loss is not accounted for in the prototypes.
ce	Tables 6.5.6.1-1 and 6.5.6.1-2	Raises minimum threshold for energy recovery.	Decreases Energy Use	Yes	Raises minimum exhaust air energy recovery threshold.
cf	6.1.1.3.1	Requires replacement HVACR equipment to meet most Section 6 requirements.	Decreases Energy Use	No	Requires replacement equipment to be more energy-efficient. Excluded from quantitative analysis because analysis considers new construction only.
cg	9.4.2	Reduces exterior lighting power allowances.	Decreases Energy Use	Yes	
ch	Tables 9.5.1 and 9.6.1	Reduces interior lighting power allowances.	Decreases Energy Use	Yes	

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<b>Addendum</b>	<b>Code Sections Affected</b>	<b>Code Change Summary Between ASHRAE 90.1-2013 and ASHRAE 90.1-2016</b>	<b>Impact on Energy Use</b>	<b>Included in quantitative Analysis</b>	<b>Discussion</b>
ci	5.5.4.5	Modifies fenestration orientation requirements.	Decreases Energy Use	Yes	Increases stringency of fenestration orientation requirements.
cq	6.5.5.2.1	Bases variable speed thresholds for heat rejection fans on motor power, including service factor.	Decreases Energy Use	Yes	Includes service factor in the heat rejection VFD threshold, effectively lowering the threshold.
cv	3.2, 10.4.1, Tables 10.8.1, 10.8.2, and 10.8.3	Increases motor efficiencies.	Decreases Energy Use	No	Excluded from quantitative analysis because motors are a federally regulated product not captured in determination.
cy	3.2, 6.4.1.1, Table 6.8.1-14	Adds definition for indoor pool dehumidifier and moisture removal efficiency. Adds new table with efficiency requirements and rating conditions.	Decreases Energy Use	No	Adds new requirements for pool dehumidifiers. Excluded from quantitative analysis because typical designs as represented by the prototypes do not include indoor pools.
dd	6.5.4.2, Table 6.5.4.2	Reduces the threshold for variable flow pumping requirements for chilled water pumps and adds requirement for heating water pumps.	Decreases Energy Use	Yes	
dg	5.4.3.2	Establishes leakage requirements for glazed, power-operated sliding and folding doors. Provides default U-factors for unlabeled metal coiling and other metal non-swinging doors.	Increases Energy Use	No	Allows higher air leakage for glazed, power-sliding and folding doors. Excluded from quantitative analysis because typical designs as represented by the prototypes do not include these doors.
dk	TABLE 6.8.1-7	Increases the minimum efficiency for axial fan closed circuit cooling towers.	Decreases Energy Use	No	Excluded from quantitative analysis because closed circuit cooling towers are not included in the prototypes.
do	9.4.1	Adds efficacy requirements for lighting installed in dwelling units.	Decreases Energy Use	Yes	Requires high efficiency dwelling unit lighting.
dp	9.4.1.1	Adds exception to restriction on automatic energizing of lighting for open office spaces.	Decreases Energy Use	No	Allowing the use of available advanced control systems that were previously not possible to install without the exception. Excluded from quantitative analysis because the exception is not used by typical designs as represented by the prototypes.

Table 2 Commercial Code Change Summary for ASHRAE 90.1- 2016 (continued)

<b>Addendum</b>	<b>Code Sections Affected</b>	<b>Code Change Summary Between ASHRAE 90.1-2013 and ASHRAE 90.1-2016</b>	<b>Impact on Energy Use</b>	<b>Included in quantitative Analysis</b>	<b>Discussion</b>
dq	9.6.2	Reduces retail display lighting adder.	Decreases Energy Use	Yes	
dr	3.2, 9.6.2	Reduces decorative lighting adder.	Decreases Energy Use	No	Excluded from quantitative analysis because the prototypes do not include decorative lighting.
du	6.5.1	Requires water-side economizers for chilled water systems including non-fan systems, such as radiant cooling or passive chilled beam systems.	Decreases Energy Use	No	Expands the application of economizers which reduces the reliance on mechanical cooling for more systems. Excluded from quantitative analysis because typical designs do not include radiant cooling or passive chilled beams.
el	6.3.2, 6.4.3, 6.4.3.12	Adds fault detection requirements for DX equipment with economizers.	Decreases Energy Use	No	Allows fault detection to notify operators that systems are malfunctioning. Excluded from quantitative analysis because the analysis does not take credit for verification or commissioning.