Energy Code Analysis - Current Requirements & What is Coming
International Energy Conservation Code & ASHRAE Standard 90.1

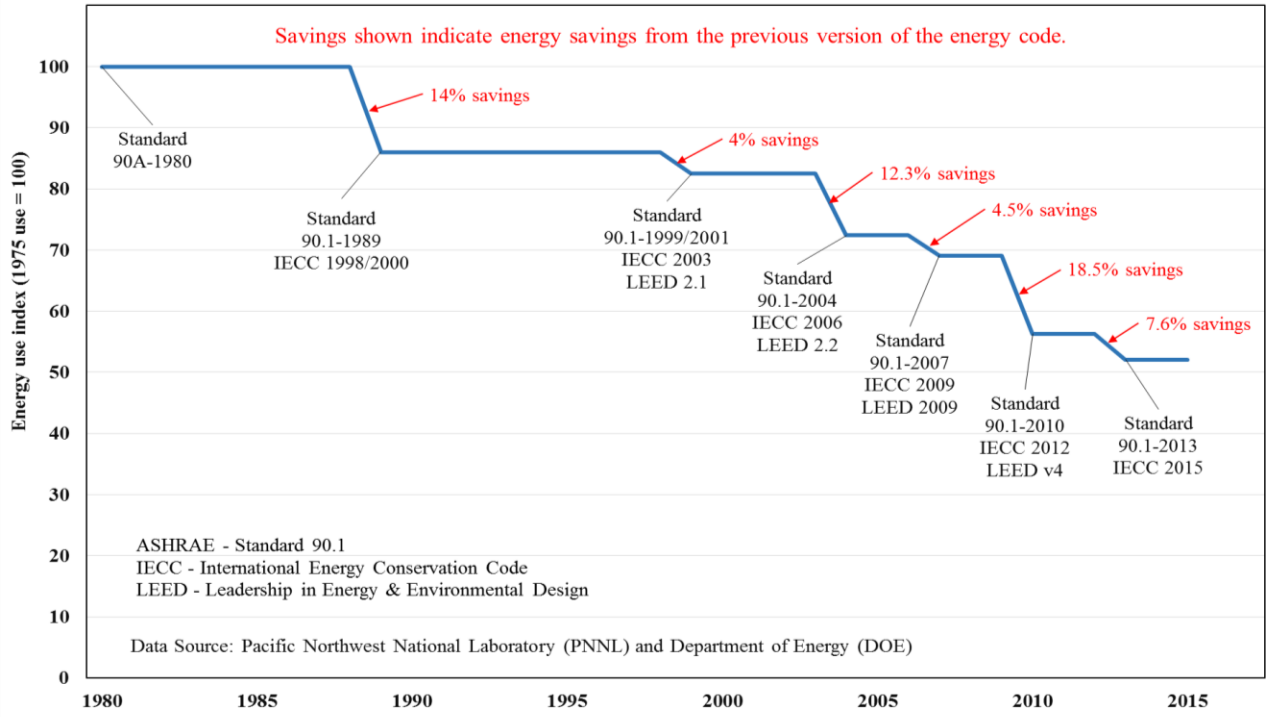
The following material provides a general summary of typical energy code requirements for an office building in the St. Louis, MO climate zone, and how they are changing. As one might expect, as time marches forward, the various code requirements become more stringent and new features are often added.

The data table on the following pages compares:

- The International Energy Conservation Code (IECC) 2012 (currently required in Illinois) with IECC 2015, and with;
- The International Green Building Code (IGCC) 2012, and with;
- ASHRAE Standard 90.1 *Energy Standard for Buildings Except Low-Rise Residential Buildings*, both the 2010 version referenced by the USGBC LEED V4, and with ASHRAE 90.1 2013, and with;
- The 50% ASHRAE Advanced Energy Design Guide for Small to Medium Office Buildings, which provides a prescriptive guide to reducing energy usage 50% below a building constructed in compliance with ASHRAE Standard 90.1-2004, as referenced by LEED V2.2.

The following graph highlights the estimated energy savings due to the energy codes over the last 35 years. Note that compliance with the requirements of the 2012 IECC offer an average energy savings of 18.5% alone.

A Historical Comparison of Commercial Energy Codes



In some cases the IECC is exceeding the requirements of the ASHRAE standard. For example, while Standard 90.1-2010 requires at least R20 roof insulation for a flat roof, the IECC increased the minimum insulation value to R25 in the 2012 code, and to R30 in the 2015 code. All these codes now require a formal commissioning effort, skylights for large spaces directly below a roof and with 15 ft. high ceilings, and an increasing emphasis on automatic daylighting controls. Feel free to contact us with any questions.

The information developed for this general energy code analysis for an office building application offers a snapshot of the current code and upcoming requirements already defined in the more recent codes and standards. Please note that this material does not provide a complete analysis; a detailed review of the appropriate code or standard should be undertaken as part of the typical design process.

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Envelope Item or System Requirement for non-Residential Buildings	Units	Energy Code IECC 2012	Green Code IGCC 2012	Energy Code IECC 2015	ASHRAE Standard 90.1-2010 (LEED v4)	ASHRAE Standard 90.1-2013	50% ASHRAE Design Guide
Climate Zone (St. Louis, MO)		**Zone 4A**	**Zone 4A**	**Zone 4A**	**Zone 4A**	**Zone 4A**	**Climate Zone 4**
Common Abbreviations: ci - Continuous Insulation, MEP-Mech., Elect. and Plbg. Systems, NM - Non-Metalic, M - Metalic window frame, hr. - hour, ft. - feet, SF - Square Feet, PF - Projection Factor							
General Requirements:					**Value by CxE**	**Code Revision**	
Maximum interior heating design temp	°F	72.0		72.0	n/a	n/a	n/a
Minimum interior cooling design temp	°F	75.0		75.0	n/a	n/a	n/a
- Minimum Deadband btwn htg. & clg.	°F	5.0		5.0	5.0	5.0	n/a
- Deadband controls (Note 36)	°F	55.0 htg./85.0 clg.		55.0 htg./85.0 clg.	55.0 htg/ NR clg.	Stpt-10 htg, Stpt+5 clg	n/a
Commissioniong of MEP systems (Note 12)		Now Required (New)	Required (Note 46)	Required	Required	Required	Required
- Service Water Heating Systems Cx		Not included	Required	Now Required (New)	Required	Required	Required
Testing & Balancing of Systems		Now Required	Required	Required	Required	Required	Required
Continuous Air Barrier		Entire Bldg Envelope	Entire Bldg Envelope	Entire Bldg Envelope	Entire Bldg Envelope	Entire Bldg Envelope	Entire Bldg Envelope
- Building Test, max leakage (Note 7)	CFM/SF envelope	0.40 (required)	0.25 (required)	Optional (Note 16)	Not required	Not required	n/a
Additional Efficiency Package Options		1 of 3 (Note 17)		1 of 6 (Note 17)	n/a	n/a	n/a
Roof System Requirements:			(Note 44)				
Roof Insulation R-value (above the deck)	hr.-°F-SF/Btu	R25 ci	R28 ci	R30 ci	R20 ci	R30 ci	R30 ci
-Roof u-value (assembly)	BTU/hr.-SF-°F	0.039	0.035	0.032	0.048	0.032	0.032
Roof Insulation R-value (attic)	hr.-°F-SF/Btu	R38	R43.5	R38	R38	R49	R49
-Roof u-value (assembly)	BTU/hr.-SF-°F	0.027	0.024	0.027	0.027	0.021	0.021
Roof Surface Data:			2:12 or less slope				
- Mininum 3 year solar reflectance		0.55	0.55	0.55	Not required	Not required	n/a
- Minimum 3 year thermal emittance		0.75	0.75	0.75	Not required	Not required	n/a
- Minimum3 year solar reflectance index		64	60	64	Not required	Not required	n/a
Wall System Requirements:			(Note 44)				
Walls above grade R-value (wood framed)	hr.-°F-SF/Btu	R20 or R13 + R3.8 ci	n/a	R20 or R13 + R3.8 ci	R13	R20	R13 + R7.5 ci
-Walls U-value (wood framed, assembly)	BTU/hr.-SF-°F	0.064	0.058	0.064	0.089	0.064	0.048
Walls above grade R-value (metal framed)	hr.-°F-SF/Btu	R13 + R7.5 ci	n/a	R13 + R7.5 ci	R13 + R7.5 c.i.	R13 + R7.5 c.i.	R13 + R7.5 c.i.
-Walls U-value (metal, assembly) (Note 13)	BTU/hr.-SF-°F	0.064	0.058	0.064	0.064	0.064	0.064
Walls below grade R-value	hr.-°F-SF/Btu	R7.5 ci	n/a	R7.5 ci	Not required	R7.5 ci	R7.5 ci
-Walls U-value (assembly)	BTU/hr.-SF-°F	0.119	0.107	0.119	1.14	n/a	n/a
Windows:			(Note 44)				
Window U-value (assembly) - Fixed	BTU/hr.-SF-°F	0.38	0.34	0.38	0.40 NM, 0.55 M	0.35 NM, 0.42 M	0.38 NM , 0.39 M
- Window R-value fixed (by CxE)	hr.-°F-SF/Btu	R2.63	R2.94	R2.63	R2.5 NM, R1.82 M	R2.86 NM, R2.38 M	R2.63 NM, R2.56 M
Window U-value (assembly) - Operable	BTU/hr.-SF-°F	0.45	0.41	0.45	0.40 NM, 0.55 M	0.35 NM, 0.5 M	0.38 NM , 0.39 M
- Window R-value operable (by CxE)	hr.-°F-SF/Btu	R2.22	R2.43	R2.22	R2.5 NM, R1.82 M	R2.86 NM, R2.00 M	R2.63 NM, R2.56 M
Window U-value (assembly) - Entry Doors	BTU/hr.-SF-°F	0.77	0.69	0.77	0.85 M	0.77 M	n/a
- Window R-value operable (by CxE)	hr.-°F-SF/Btu	R1.30	R1.44	R1.30	R1.17	R1.30	n/a
Maximum Vertical fenestration % wall area	%	30%		30%	40%	40%	40%
- Max. vert. fenes. w/daylighting controls	%	40%, Note 2		40%, Note 2	n/a	n/a	n/a
Window SHGC before adjust's: (Note 3)					0.40, all framing	0.40, all framing	0.26 NM, 0.38 M
- East, south & west, no overhang	PF < 0.2	0.40	See Table 7.4.2.6 SHGC Multipliers for Permanent Projections	0.40	See Table 5.5.4.4.1 SHGC Multipliers for Permanent Projections	See Table 5.5.4.4.1 SHGC Multipliers for Permanent Projections	n/a
- w/in 45° of true north, no overhang	PF < 0.2	0.40		0.53			n/a
- East, south & west, small overhang	0.2 ≤ PF < 0.5	0.48		0.48			n/a
- w/in 45° of true north, small overhang	0.2 ≤ PF < 0.5	0.44		0.58			n/a
- East, south & west, large overhang	PF ≥ 0.5	0.64		0.64			n/a
- w/in 45° of true north, large overhang	PF ≥ 0.5	0.48		0.64			n/a

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Doors:					**Value by CxE**	**Code Revision**	
Opaque Swinging Door U-value maximun	BTU/hr.-SF-°F	0.61	0.55	0.61	0.70	0.50	0.50
-Door R-value minimum (by CxE)	hr.-°F-SF/Btu	R1.64	R1.81	R1.64	R1.43	R2.00	R2.00
Slab on Grade Requirements:							
Unheated Slab on Grade Floors F-value	BTU/hr.-ft.-°F	0.54	0.49	0.54	0.73	0.52	n/a
- Loss per foot at 70°F dT (by CxE)	Btu/hr.-ft.	37.8	34.3	37.8	51.1	36.4	n/a
- Foundation insulation R-value, minimum	hr.-°F-SF/Btu	R10 (Note 1)		R10 (Note 1)	Not required	Not required	R15 (Note 1)
Skylights:							
Skylight maximum U-value (assembly)	BTU/hr.-SF-°F	0.50	0.45	0.50	0.69 (Note 30)	0.50 (Note 30)	n/a
- Skylight R - value (by CxE)	hr.-°F-SF/Btu	R2.0	R2.2	R2.0	R1.44 (Note 30)	R2.0	n/a
Increased max U-value w/daylight controls	BTU/hr.-SF-°F	0.75		0.75	n/a	0.75, (Note 28)	n/a
- Decreased Skylight R - value (by CxE)	(hr.-°F-SF/Btu)	R1.33 (Note 4)		R1.33 (Note 4)	n/a	R1.33 (Note 4)	n/a
Skylight SHGC, base	no units	0.40	0.36	0.40	0.39	0.40	n/a
- Increased Skylight SHGC w/daylight contrls	no units	0.60, (Note 5)		0.60, (Note 5)	Exempt, (Note 29)	Exempt, (Note 29)	n/a
Maximum Skylight Area	% gross roof area	3%		3%	5%	3%	5%
- Increased Max Area w/daylight controls	% gross roof area	5%, (Note 6)		5%, (Note 6)	n/a, (Note 31)	6%, (Note 27)	n/a
Minimum Skylight Area: (Note 15)							
- Space size	SF	> 10,000 SF		> 2,500 SF	> 5000 SF	> 2,500 SF	n/a
- Minimum skylight area	%	3% (Note 15)		3% (Note 15)	5% (Note 15)	3% (Note 15)	n/a
Maximum Infiltration Rates:							
- Windows	CFM/SF window	0.2 (Note 8)	n/a	0.2 (Note 8)	0.2	0.2	n/a
- Swinging and sliding doors	CFM/SF door	0.2 (Note 8)	n/a	0.2 (Note 8)	0.2	0.4 to 1.0	n/a
- Skylights	CFM/SF skylight	0.2 (Note 8)	n/a	0.2 (Note 8)	0.3	0.3	n/a
- Curtainwall	CFM/SF	0.06	n/a	0.06	0.06	0.06	n/a
- Storefront glazing	CFM/SF	0.06	n/a	0.06	0.06	0.06	n/a
Vestibules (for main entrances)	n/a	Required	Not Mentioned	Required	Required	Required	Recommended
Typical Office Lighting Load Allowances:							
- Conference/Meeting Rm.	W/SF	1.20	1.11	1.23	1.23	1.23	0.75
- Office Open plan	W/SF	1.00	0.83	0.98	0.98	0.98	0.75
- Office Enclosed	W/SF	1.10	1.05	1.11	1.11	1.11	0.75
- Restroom	W/SF	1.00	n/a	0.98	0.98	0.98	0.75
- Elect/Mechanical	W/SF	1.10	n/a	0.95	0.95	0.42	0.75
- Lobby	W/SF	1.10	0.49 to 1.9	0.90	0.52 to 2.00	0.90	0.75
- Office (Whole Bldg. Area Method)	W/SF	0.90	0.86	0.82	0.90	0.82	0.75
- Parking areas and drives (Note 47)	W/SF	0.04 to 0.13	n/a	0.04 to 0.13	0.04 to 0.13	0.04 to 0.13	0.10
- 24 hour lighting space	W/SF	n/a	n/a	n/a	n/a	n/a	0.075
Lighting Controls:							
- 50% light level reduction w/manual controls		Required		Required	Required (Note 24)	Required (Note 24)	Rec'd for certain spaces
- Occupancy sensors (Note 10,11)		Required (Note 10,11)		Required (Note 10,11)	May be req'd (Note 32)	Optional (Note 35)	Recommended
- Daylighting controls (Note 23, 33)		Req'd for daylit spaces		Req'd for daylit spaces	Req'd for daylit spaces	Req'd for daylit spaces	Recommended
Elevator Lighting and Ventilation (Note 41)		Not Required	Required	Required	Required	Required	Not Mentioned

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HVAC Equipment:					**Value by CxE**	**Revision**	Note 34
Sample Equipment Efficiencies:							
- Air cooled < 65 MBH	n/a	13.0 SEER	14.0 SEER	13.0 SEER	13.0 SEER	14.0 SEER	15.0 SEER
- Air cooled ≥ 65 MBH, < 135 MBH	n/a	11.0 EER or 11.2 IEER	11.3 EER or 11.8 IEER	11.0 EER or 11.2 IEER	11.0 EER or 11.2 IEER	11.0 EER or 11.2 IEER	11.5 EER or 12.8 IEER
- Air cooled ≥ 135 MBH, < 240 MBH	n/a	10.8 EER or 11.0 IEER	11.3 EER or 11.8 IEER	10.8 EER or 11.0 IEER	10.8 EER or 11.0 IEER	10.8 EER or 11.0 IEER	11.5 EER or 12.3 IEER
Demand controlled ventilation (Note 9)	n/a	Spaces > 500 SF		Spaces > 500 SF	Spaces > 500 SF	Spaces > 500 SF	Recommended
Energy recovery ventilation systems (Note 21)	n/a	May be required	May be required	May be required	May be required	May be required	Recommended
Air Side System Requirements:							
- Economizer required	n/a	All systems ≥ 33 MBH	All systems ≥ 33 MBH	All systems ≥ 54 MBH	All systems ≥ 54 MBH	All systems ≥ 54 MBH	All systems ≥ 54 MBH
- Static pressure reset (Note 19)	n/a	Required, DDC VAV		Required, DDC VAV	Required, DDC VAV	Required, DDC VAV	n/a
- Discharge air temperature reset (Note 20)	n/a	--- 25% min. reset required ---			25% min. reset required		50°F to 58°F
- Motorized dampers, 3 or more stories high	n/s	Required		Required	Required	Required	n/a
Supply Fan System Power Limits:							
- Motor Nameplate HP - Constant Volume	HP	hp ≤ CFMs × 0.0011		hp ≤ CFMs × 0.0011	hp ≤ CFMs × 0.0011	hp ≤ CFMs × 0.0011	n/a
- Motor Nameplate HP - Variable Volume	HP	hp ≤ CFMs × 0.0015		hp ≤ CFMs × 0.0015	hp ≤ CFMs × 0.0015	hp ≤ CFMs × 0.0015	n/a
- Fan system BHP - Constant Volume	BHP	bhp ≤ CFMs × 0.00094 + A (Note 18)			bhp ≤ CFMs × 0.00094 + A (Note 18)		n/a
- Fan system BHP - Variable Volume	BHP	bhp ≤ CFMs × 0.0013 + A (Note 18)			bhp ≤ CFMs × 0.0013 + A (Note 18)		n/a
Fractional HP Fan Motor Requirements	(Note 42)	Not Required		Required	Not Required	Required	Not Mentioned
Furnace, Gas Fired < 225 MBH (Note 22)	n/a	78% AFUE min.	90% AFUE	78% AFUE min.	78% AFUE min.	78% AFUE min.	n/a
Fan Airflow Control (Note 38)		Not Required	Variable Req'd, ≥ 1 hp	Required	Not Required	Required	Not Mentioned
Hydronic Systems and Boilers:							
HW Boiler, Gas Fired < 300 MBH	n/a	80% AFUE min.	89% AFUE	80% AFUE min.	80% AFUE min.	82% AFUE min.	n/a
Boiler Turndown (Note 40)		Not Required		≥ 1000 MBH	Not Required	≥ 1000 MBH	Not Mentioned
Hydronic systems (Note 25, 26, 39)		≥ 300 MBH		Note 25, 39	≥ 300 MBH	≥ 300 MBH	
- Supply water temperature reset (Note 25)	n/a	25% min. SW-T reset or		25% min. reset required	Required (Note 25)	Required (Note 25)	n/a
- System pump flow reset (Note 26)	n/a	50 % min. flow reset		50% min. reset required	Required, >10 HP	Required, >10 HP	n/a
Kitchen Exhaust Systems (Note 37)		Not Required	Required	Required	Required	Required	Not Mentioned
Walk-in Cooler and Freezer Requirements	(Note 43)	Not Required		Required	Not Required	Required	Not Mentioned

No.	Notes:
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Gen.	The information provided in this general energy code analysis for an office building provides a snapshot of the current code and upcoming requirements already defined in the more recent codes and standards. Please note that this material does not provide a complete analysis, and that a detailed review of the appropriate code or standard should be undertaken as part of the normal design process.
1	Slab on grade floor insulation shall extend downward from the top of the floor slab at least 24" or as indicated.
2	The vertical fenestration area is allowed to be increased to a maximum of 40% of the total wall area provided no less than 50% of the conditioned floor area is within a daylight zone, automatic daylighting controls are installed in daylight zones, and Visible Transmittance (VT) of windows is ≥ 1.1 x SHGC (Solar Heat Gain Coefficient).
3	The maximum allowable Solar Heat Gain Factor (SHGF) varies based on the direction the windows face and may be increased if an overhang is provided for shading, based on the projection factor (PF). The PF is equal to horizontal projection from the face of the glazing to the edge of the overhang divided by the height of the overhang above the window sill.
4	Where skylights are installed above daylight zones provided with automatic daylighting controls, a maximum U-factor of 0.9 shall be permitted in Climate Zones 1 thru 3; and a maximum U-factor of 0.75 shall be permitted in Climate Zones 4 through 8.
5	In Climate Zones 1 through 6, skylights shall be permitted a maximum SHGC of 0.60 where located above daylight zones provided with automated daylighting controls.
6	The skylight area shall be permitted to be a maximum of 5% of the roof area provided automatic daylighting controls are installed in daylight zones under skylights.
7	The completed building shall be tested and the air leakage rate of the building envelope shall not exceed 0.40 cfm/SF at a pressure differential of 0.3 inches water gauge (75 Pa) per IECC 2012. The IGCC 2012 reduces the maximum leakage to 0.25 cfm/SF at the same pressure differential. Both the IECC 2012 and IGCC 2012 require leakage testing, while the IECC 2015 makes this optional.
8	The maximum air rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa).
9	Demand control ventilation (DCV) shall be provided for spaces larger than 500 square feet and with an average occupant load of 25 people per 1000 square feet of floor area (as established in Table 403.3 of the International Mechanical Code). (40 people per 1000 SF of floor area is the requirement for ASHRAE 90.1-2010.)
10	Occupancy sensors shall be installed in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms and janitorial closets, and other spaces 300 square feet or less enclosed by floor-to-ceiling height partitions. These automatic control devices shall be installed to automatically turn off lights within 30 minutes of all occupants leaving the space, and shall either be manual on or shall be controlled to automatically turn the lighting on to not more than 50 percent power.
11	Full automatic-on controls shall be permitted to control lighting in public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.
12	System commissioning is now required for a building where the cooling capacity is ≥ 480 MBH or 40 tons. Included requirements: Commissioning Plan, Systems adjusting and balancing, Function Performance Testing (FPT), both a preliminary and final Commissioning Report, operating and maintenance manuals, and narrative of how the systems are intended to operate. Similar for lighting control system testing and verification.
13	Metal framed wall systems result in thermal bridging that reduces the insulation value, requiring higher levels of insulation to meet the Energy Code. For example: a 3.5" stud metal wall with R-13 batt insulation and 16" stud spacing provides an effective R-value of only R-5.98; similar 6" metal stud wall with R-19 batt insulation provides only 7.03 R-value. See table C402.1.4.1 in the 2015 IECC.
14	NM constitutes nonmetal framing, and M constitutes metal framing.
15	In an enclosed space greater than area indicated, directly under a roof with ceiling heights greater than 15 feet, and used as an office, lobby, atrium, concourse, corridor, storage, gymnasium/exercise center, convention center, automotive service, manufacturing, non-refrigerated warehouse, retail store, distribution/sorting area, transportation, or workshop, the total daylight zone under skylights shall be not less than half the floor area and shall provide the minimum skylight area indicated (see exceptions). For ASHRAE 90.1-2013 and 90.1-2010, a skylight Visible Transmittance of 0.4 minimum, or minimum skylight effective aperture of 1% is additionally required.
16	Building envelope testing is now optional and only required if the listed construction requirements are not met.
17	In addition to the base requirements, more efficient parameters have to be selected for one of multiple system options. In the 2012 IECC the three options included better HVAC system performance, better lighting system performance, or the addition of a renewable energy system. In the 2015 IECC the following options were added: enhanced lighting controls, dedicated outside air systems, or high efficiency service water heating systems.
18	Fan power limits primarily apply to supply fans, return/relief fans and fan powered air terminal units, but also reference exhaust fans. Several exceptions apply.
19	Variable air volume systems with DDC controls for the individual zones are required to include reset of the duct static pressure setpoint from the VAV box position.
20	HVAC systems with multiple zones are required to include discharge air temperature (DAT) reset controls from either zone load or to outside air temperature. The reset should be at least 25% of the difference between the design DAT and the space design temperature. (For ASHRAE 90.1-2013 and 90.1-2010, controls that adjust reset based on zone humidity are allowed.)
21	For IECC 2012, energy recovery ventilators (ERV) are required for systems with supply air flow ≥ 5500 cfm and outside air intake ≥ 30%. Other requirements apply to smaller systems with even higher outside air intake values. ASHRAE 90.1-2013, ASHRAE 90.1-2010, and IGCC 2012 requirements are the same for this example.

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22	Gas-fired furnaces are typically manufactured with at least 80% AFUE due to DOE standards set in 2007, and taking effect on January 1, 2015. DOE is considering raising the efficiency to 92% AFUE, which requires condensing furnaces, but this will not take effect before 2021. In either case, condensing furnaces should always be considered.
23	For ASHRAE 90.1-2013, Automatic Daylight Responsive Controls for side lighting is required for (1) any spaces where combined input power of all general lighting inside the primary side-lighted areas is ≥ 150W or (2) any spaces where combined input power of all general lighting is within the primary secondary side-lighted areas is ≥ 300W. See ASHRAE 90.1-2013 9.4.1.1 for Automatic daylight responsive controls for top-lighting.
24	For ASHRAE 90.1-2013, bi-level lighting control (at least one intermediate step shall be between 30% and 70% of full lighting power) is required for some spaces. For ASHRAE 90.1-2010, an intermediate step between 30% and 70% is also required. See section ASHRAE 90.1-2010 9.4.1.2 for exceptions.
25	For ASHRAE 90.1-2013 and 90.1-2010, HW and CHW Temperature Reset requires controls that automatically reset supply water temperatures by representative building loads or by outdoor air temperature. IECC 2015 Section C403.2.5 requires that HW boilers have an automatic control that lowers the boiler water temperature setpoint based on the outside air temperature for all capacities. In Section C403.4.2.4 IECC 2012, a choice was given between a temperature reset control or variable flow for hydronic heating systems. ASHRAE 90.1-2013 lists its reset control requirements in Section 6.5.4.4 whereas ASHRAE 90.1-2010 lists its reset control requirements in Section 6.5.4.3.
26	For ASHRAE 90.1-2013 and 90.1-2010, HVAC pumping systems having a total pump system power > 10 HP that include applicable control valves shall be designed for variable fluid flow and be capable of reducing pump flow rates to 50% at least. See Section 6.5.4.2 for more information.
27	The increased skylight percentage is allowed if the skylights meet all of the criteria in Exception (1) to 5.5.4.4.2 ASHRAE 90.1 - 2013.
28	For ASHRAE 90.1 -2013, the skylights are allowed a maximum U-value of 0.75 provided they meet all of the criteria in Exception (1) to Section 5.5.4.4.2.
29	For ASHRAE 90.1 -2013 and 90.1 - 2010, the skylights are exempt from SHGC requirements provided they meet all of the criteria in Exception (1) in Section 5.5.4.4.2 SHGC of Skylights.
30	For ASHRAE 90.1-2013, a max assembly is given for all types of skylights. For ASHRAE 90.1-2010, skylights are listed for different types and different percentages of roof area; the skylights without curb, 2.1% - 5.0% choice was chosen for the purposes of this comparison.
31	For ASHRAE 90.1-2010, buildings that have a skylight-roof-ratio greater than 5% must use the Building Envelope Trade-Off Option or the Energy Cost Budget Method.
32	For ASHRAE 90.1-2010, an occupant sensor or a time switch shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space in many common space types. See 9.4.1.2.b for more information.
33	For ASHRAE 90.1-2010, Automatic Daylighting Controls for Primary Side-lighted Areas are required when the primary side-lighted area in an enclosed space is ≥ 250 SF. See Section 9.4.1.4 for more information. See Section 9.4.1.5 for requirements for Automatic Daylighting Controls for Top-lighting.
34	For the ASHRAE 50% Design Guide, VAV DX with indirect gas-fired heat was chosen as the example system choice.
35	For ASHRAE 90.1-2013, occupancy sensors fall under the Scheduled Shutoff category under Section 9.4.1.1. Table 9.6.1 lists the minimum control requirements using either method.
36	For ASHRAE 90.1-2013, heating systems should be capable of maintaining unoccupied zone temperatures at a heating setpoint at least 10°F below the occupied heating setpoint. Cooling systems should be capable of maintaining unoccupied zone temperatures at least 5°F above the occupied cooling setpoint to prevent high space humidity levels.
37	Kitchen exhaust requirements are not addressed in IECC 2012. In IECC 2015 Section C403.2.8, various requirements are listed. ASHRAE 90.1-2010, 90.1-2013, and IECC 2015 have the same requirements and same max net exhaust flow rate per linear foot of hood length requirements.
38	Fan Airflow Control refers to minimum required fan airflow staging, with typically at least 2 stages required. For IECC 2015, Section C403.4.1.1 and Table C403.4.1.1 can be reviewed. ASHRAE 90.1-2013 lists its requirements in Table 6.5.3.2.1 and Section 6.5.3.2.1. The requirements for IECC 2015 and ASHRAE 90.1-2013 are the same. ASHRAE 90.1-2010 and IECC 2012 do not have requirements on fan airflow control.
39	2012 IECC Section C403.4.3.4 requires hydronic heating and cooling systems over 300 MBH capacity to include either supply-water-Temperature (SW-T) reset or variable flow controls. 2015 IECC Section C403.4.2.4 changes the capacity threshold to 500 MBH, but requires SW-T reset (25% of design minimum), variable flow (if motor > 10 hp with ≥ 3 control valves, 50% minimum flow reduction) , and a variable (or stepped) pumping control. IECC 2015 requires supply water temperature reset for boilers of all capacities.
40	2015 IECC Section C403.4.2.5 requires that boiler systems with a design input of 1000 MBH or more comply with different turndown ratios, using multiple single input boilers, one or more modulating boilers or a combination. IECC 2012 does not have a boiler turndown requirement. See ASHRAE 90.1-2013 Section 6.5.4.1 for the specific requirements.
41	2012 IECC does not have requirements for elevators. 2015 IECC Section C405.9.1 requirements include (1) cab lighting to have efficacy ≥ 35 lumens/W, (2) ventilation fans in elevators without air-conditioning systems shall not consume more than 0.33 watts/cfm at the max fan speed, and (3) cab lighting and ventilation should be off when the elevator is not used for over 15 minutes. ASHRAE 90.1-2010 and ASHRAE 90.1-2013 have the same requirements as 2015 IECC. The IGCC 2012 has the same requirements as IECC 2015 with some additions and the exception of IECC 2015 (3).
42	IECC 2015 Section C403.4.4.4 requires motors from 1/12 hp to under 1 hp to be ECM motors or have a minimum efficiency of 70% with exceptions. No requirement exists for fractional hp motors in IECC 2012 or ASHRAE 90.1-2010. ASHRAE 90.1-2013 has the same requirements as IECC 2015 and can be found in Section 6.5.3.5. (ECM = electrically commutated motors or brushless DC motors.)

No.	Notes:
	Common Abbreviations: ci - Continuous Insulation, MEP-Mech., Elect. and Plbg. Systems, NM - Non-Metallic, M - Metallic window frame, hr. - hour, ft. - feet, SF - Square Feet, PF - Projection Factor
Gen.	The information provided in this general energy code analysis for an office building provides a snapshot of the current code and upcoming requirements already defined in the more recent codes and standards. Please note that this material does not provide a complete analysis, and that a detailed review of the appropriate code or standard should be undertaken as part of the normal design process.
43	The 2012 IECC and ASHRAE 90.1-2010 do not have requirements for walk-in coolers and freezers. The 2015 IECC lists requirements in Section C403.2.15. The new requirements have been defined and legislated as the national manufacturing standard and described in 10 CFR 431.306; the requirements are for cover doors, insulation, evaporator fan motors, lighting, anti-sweat heaters, condenser fan motors, and their controls. ASHRAE 90.1-2013 also has requirements for walk-in coolers and freezers which can be found in Section 6.4.5.
44	IGCC 2012 Section 605.1.1 states that the building thermal envelope shall exceed the requirements of Tables C402.1.2 and C402.3 of the International Energy Conservation Code (IECC 2012 was used) by not less than 10%.
45	IGCC 2012 Section 7.4.6.1 states that the interior lighting power allowance shall be a maximum of the values determined in accordance with Sections 9.5 and 9.6 of Standard 90.1 multiplied by an LPD Factor specified in Table 7.4.6.1A for those areas where the Building Area Method is used and in Table 7.4.6.1B for those areas where the Space-by-Space Method is used (90.1-2010 was used).
46	IGCC 2012 requires a recommissioning effort 18 to 24 months after occupancy to identify if any corrections or adjustments are needed.
47	Lighting power requirements for parking areas and drives vary based on the area served and typically include four (4) lighting zones. The lighting zones vary from national park and similar rural areas to high activity commercial districts.