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What's New in Commercial Energy Codes 90.1-2016 & 2018 IECC

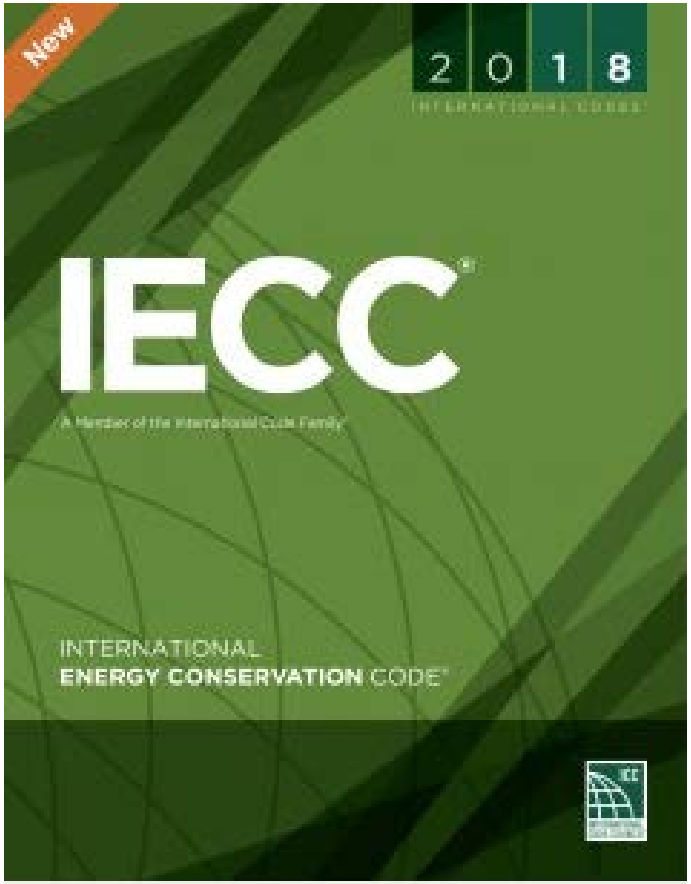
REID HART, PE
with thanks to: Bing Liu & Michael Rosenberg

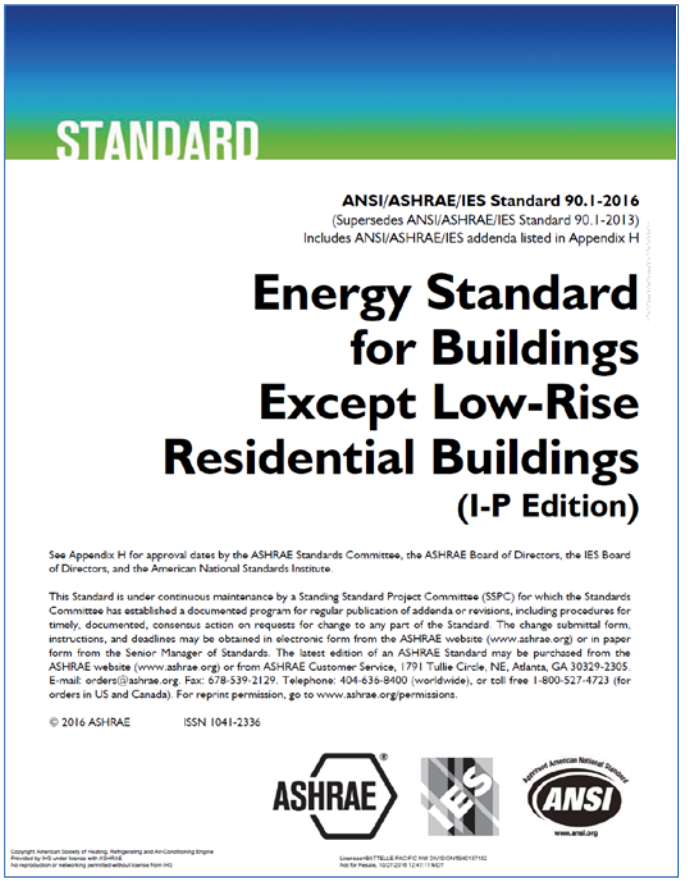
AEE St. Louis Chapter
April 10, 2018 St. Louis, MO

PNNL-SA-127543

Topics

- Major Changes in 90.1-2016 & 2018 IECC
- Savings potential from model energy codes
- Resources for energy codes





Code Adoption

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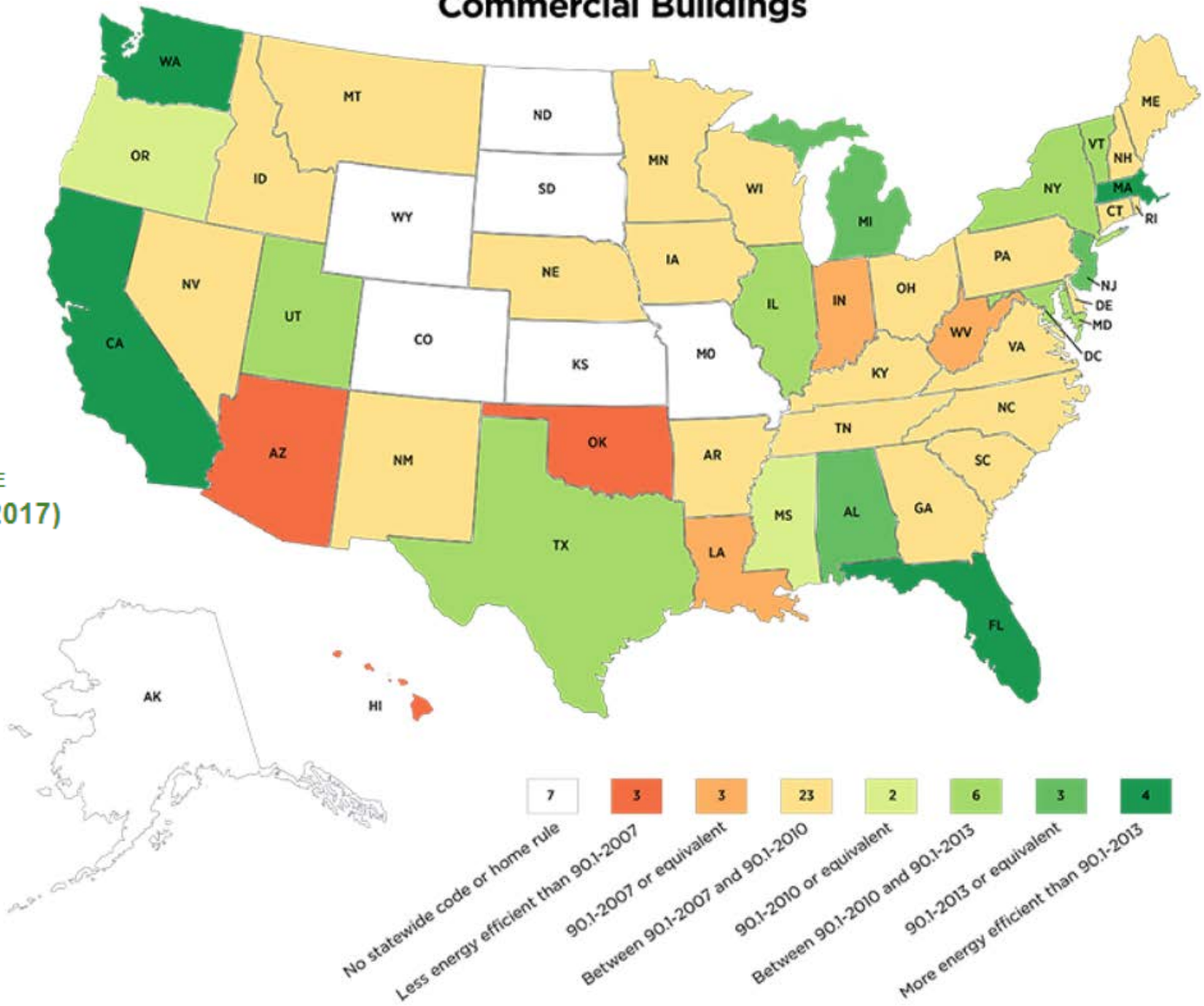
Commercial Buildings



CURRENT CODE (AS OF DECEMBER 2017)

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Major Changes in 90.1-2016 & 2018 IECC vs. 90.1-2013 & 2015 IECC

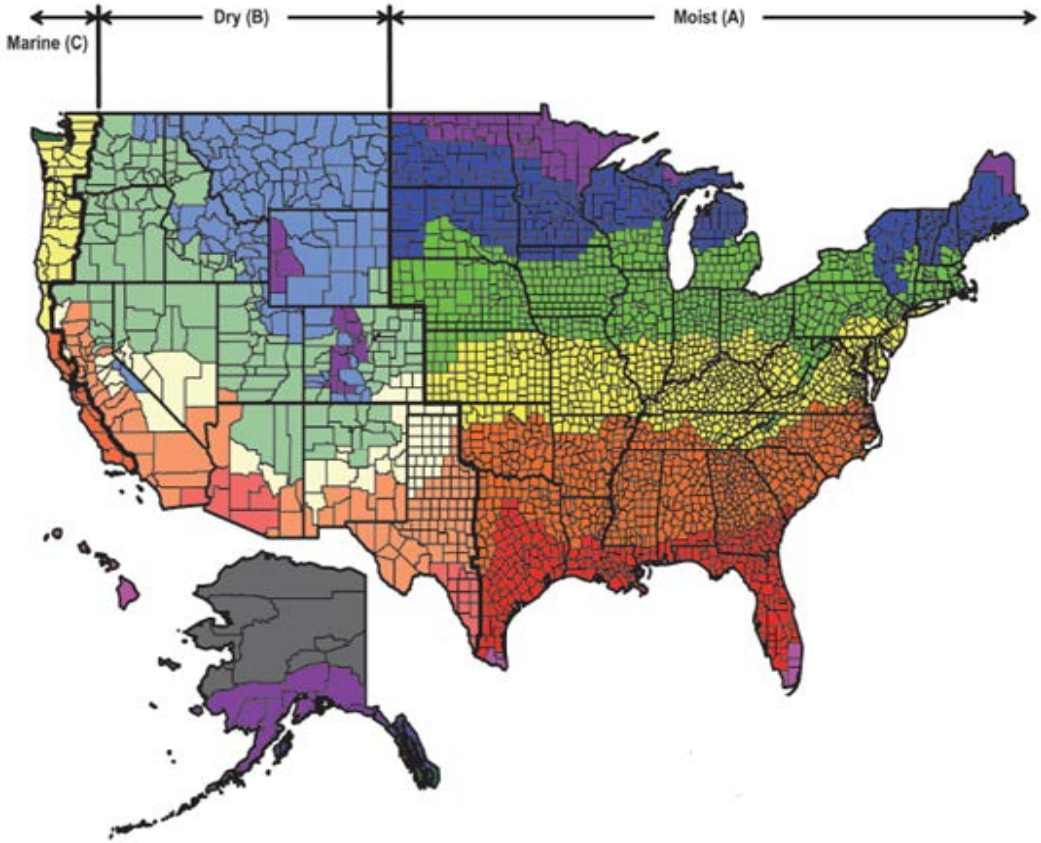
Summary of Changes

- ASHRAE 90.1-2016 : Total of 121 addenda
  - Major format changes for ease of use
  - New climate maps aligning with ASHRAE Standard 169
  - New performance-based compliance path
  - 49 of the 121 addenda have energy impact
- 2018 IECC commercial: Total of 129 approved proposals
  - Section 4 (mechanical) completely reorganized
  - 36 proposals increase energy efficiency, 3 major
  - 10 proposals reduce energy efficiency, 2 major
- Just the major changes today; not comprehensive
- Each item: savings impact & codes

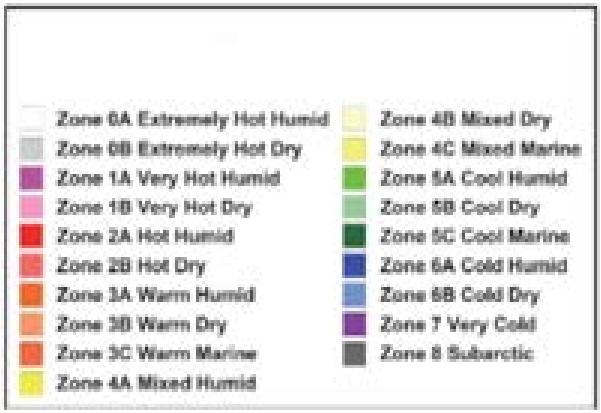
Impact	90.1	IECC
$$	✓	Not In

Climate Zone Map

- Aligns with new ASHRAE Standard 169-2013
  - Reflects global warming trends over the most recent 30 years
  - Adds new Climate Zone 0 (extremely hot)
  - Approximately 10% of US counties reassigned to a warmer climate zone
- Energy use increase of 0.18% due to less stringent insulation/ERV requirements



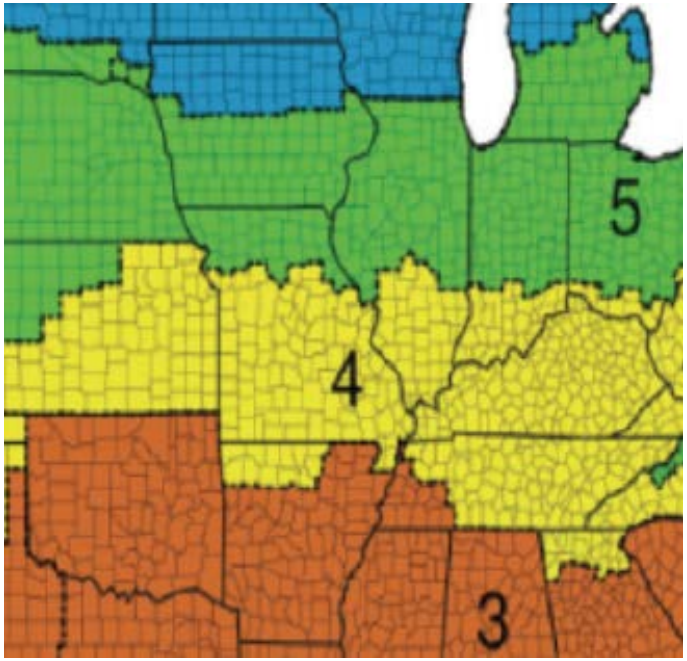
Impact	90.1	IECC
+0.18%	✓	Not In



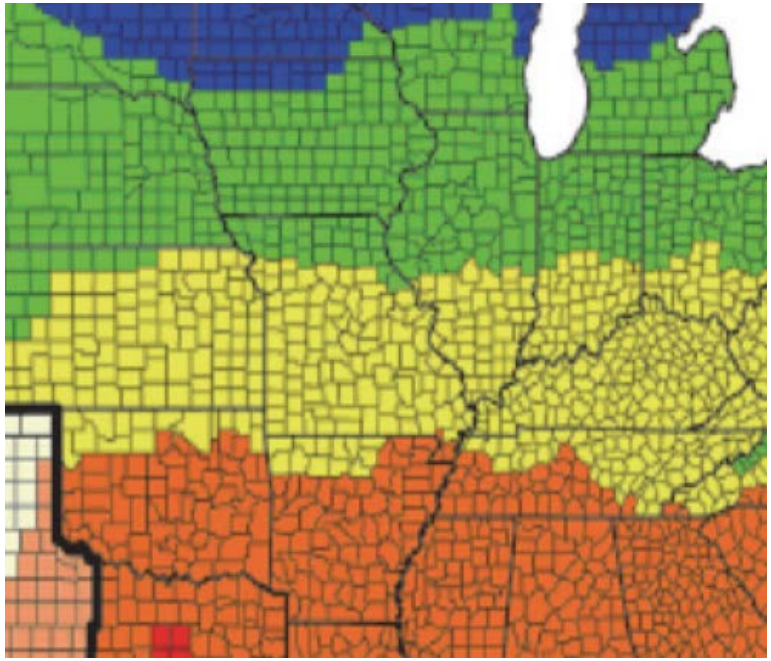
Local Climate Zone Shift

- No change in climate zones for IECC (Use Left)

90.1-2013 & IECC



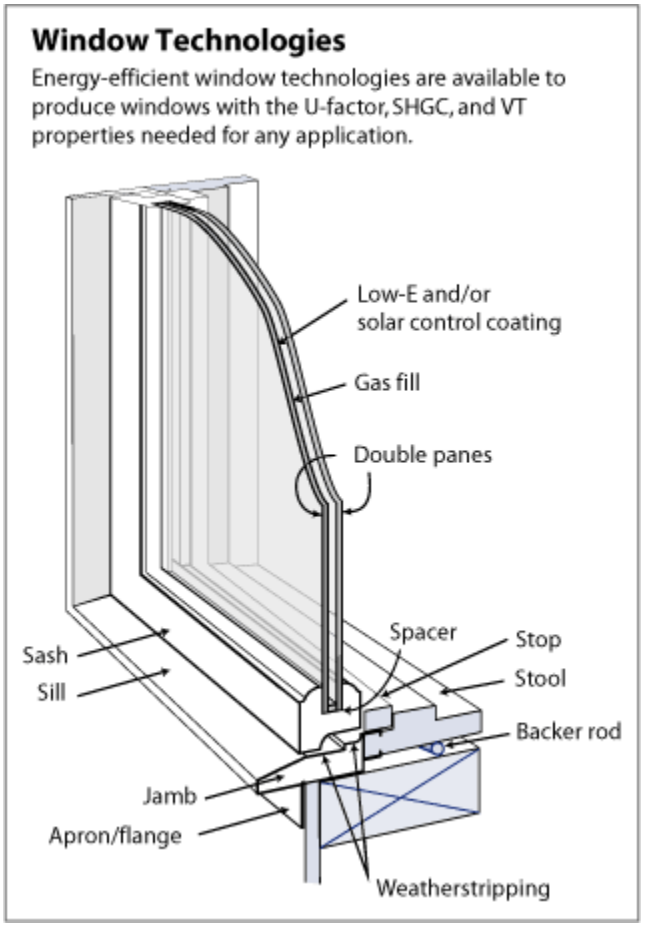
90.1-2016



Envelope

- Fenestration
  - 90.1-2016 includes a comprehensive update to the fenestration prescriptive requirements
    - U-factor reduced by as much as 22% in some climate zones
    - SHGC reduced by as much as 12%
  - IECC includes only SHGC reductions

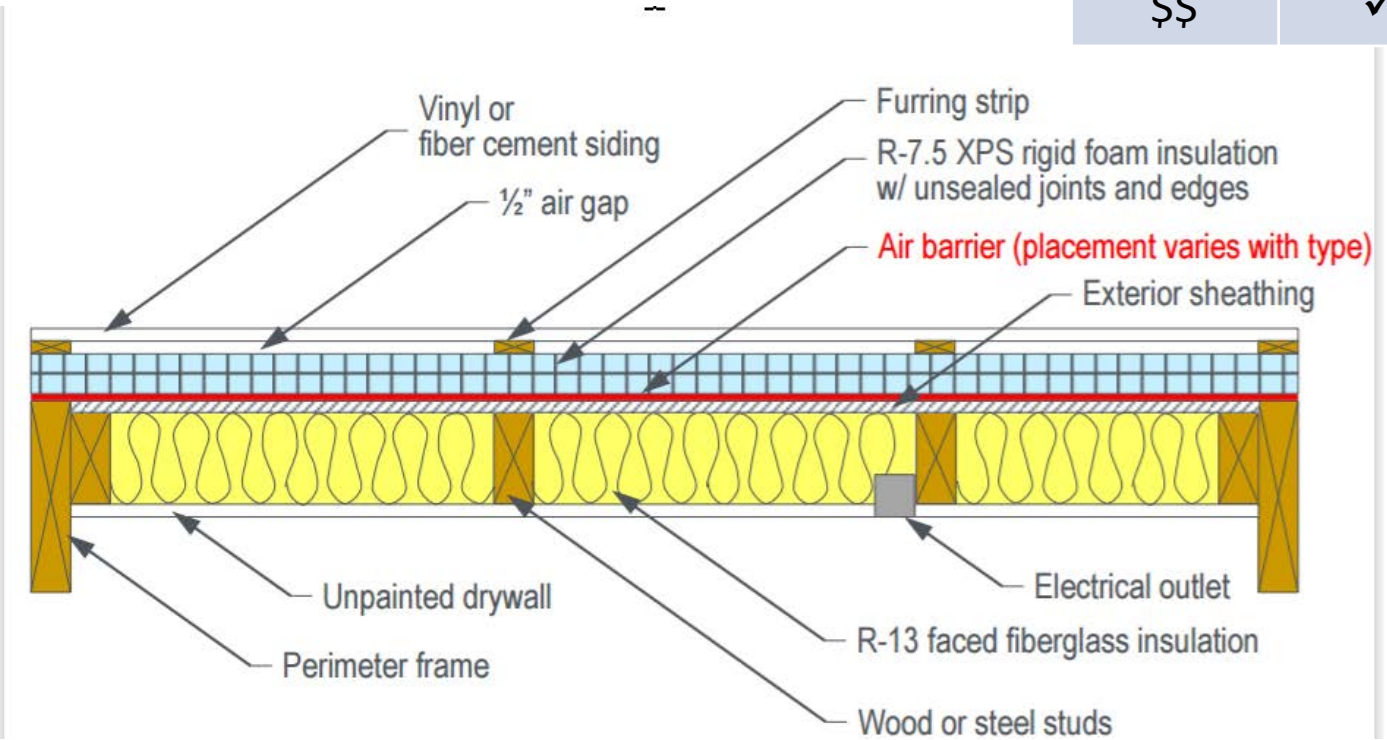
Impact	90.1	IECC
$$/$	✓	Only SHGC



Envelope

- Building Air Leakage
  - Whole building air leakage test optional for compliance
  - Air barrier design and installation verification required

Impact	90.1	IECC
$$	✓	Not In



Mechanical

Increased HVAC Equipment Efficiency Requirements

Chillers

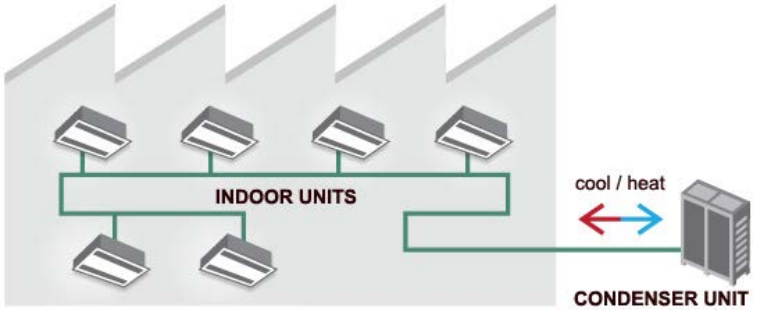
Heat Pumps

Computer Room AC

Dedicated Outdoor Air*

Rooftop AC Units

Cooling Towers



Variable Refrigerant Flow

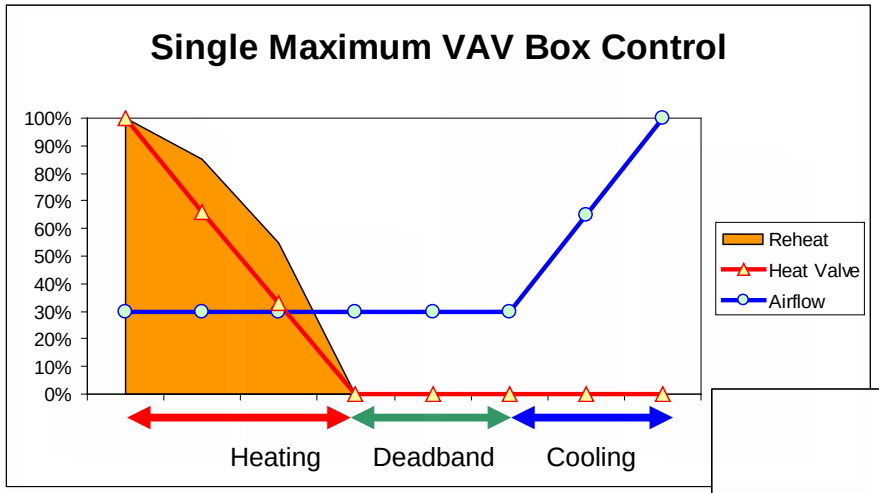
Note: some items updated (water heaters, furnace, boiler, heat pump, air conditioner, PTAC, electric motors and transformers); however, some not updated (VRF, CRAC, cooling towers)

* Newly regulated equipment

Impact	90.1	IECC
$	✓	Varies

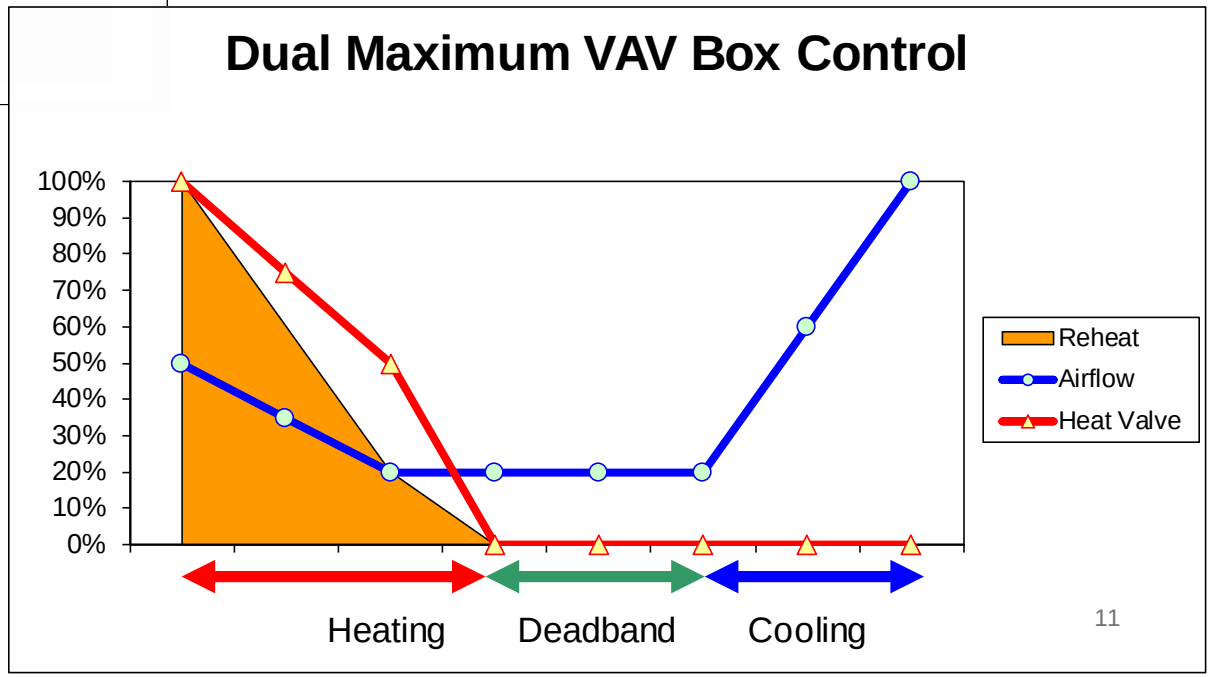
Mechanical

- Add dual maximum requirement for VAV zones:



- Old single max has higher deadband airflow; more reheat
- Dual max reduces ventilation load in heating and reduces reheat energy use

Impact	90.1	IECC
$$$	Already	✓



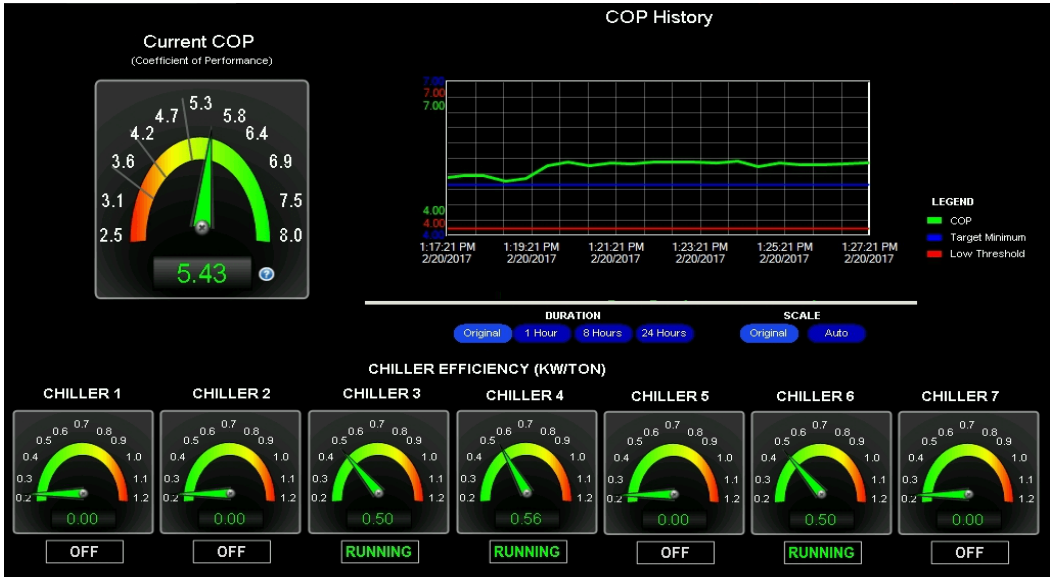
Mechanical

Impact	90.1	IECC
$	✓	✓

- Hotel/Motel Guest Room Controls
  - Heating, cooling, & ventilation automatically reduced when unoccupied; applies when >50 guest rooms

Impact	90.1	IECC
$	✓	Not In

- Chilled Water Plant Metering
  - Large plants required to meter for electricity and efficiency



www.affinityenergy.com

Mechanical

- Variable flow pumping

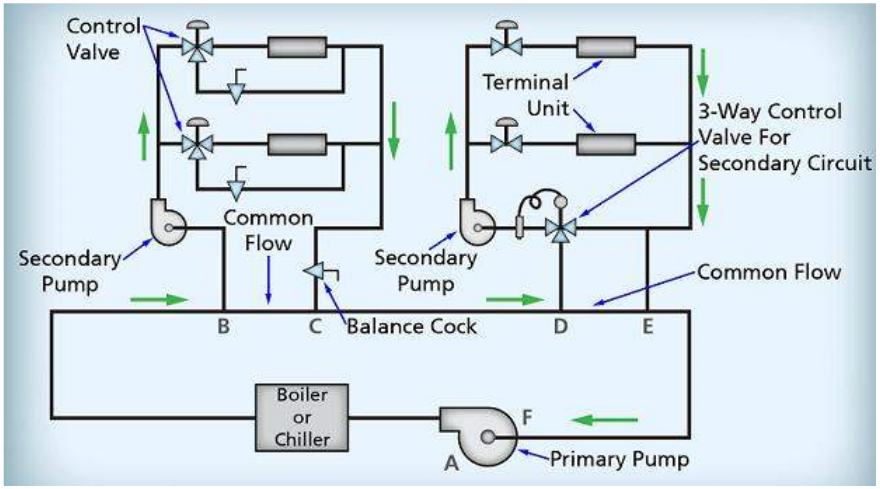
Impact	90.1	IECC
$	✓	✓

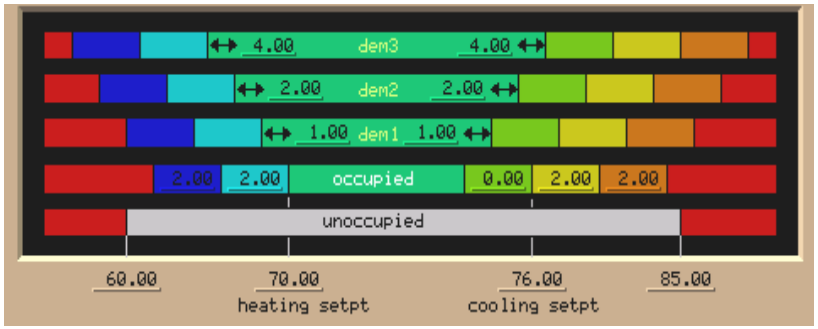
  - Variable speed drive required on smaller chilled water pumps (threshold reduction) and large heating pumps (new)

- Configuration required

Impact	90.1	IECC
$	✓	✓

  - Controls must be configured with required setpoints at time of inspection, not just “capable of”





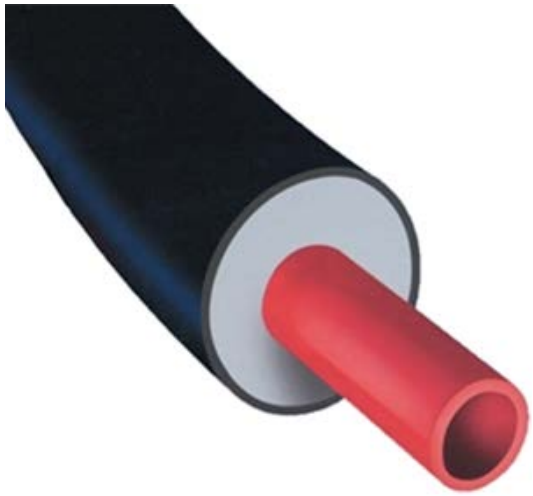
Service Water Heating

- Runout pipe insulation
  - ASHRAE: first 8 feet branch after heat trace or recirculated pipe
  - All SWH pipe must be insulated in IECC

Impact	90.1	IECC
$	✓	N/A

- Reduced flow showerhead
  - Reduce flow from 2.5 to 2.0 gpm
  - *ICC board has decided the plumbing code rules fixture flow*

Impact	90.1	IECC
$$	Not In	✓



Lighting

Impact	90.1	IECC
$$$	✓	✓

- Reduced Lighting Power Allowance
  - Primarily based on improved efficacy of LED lighting
  - Exterior lighting power reduced an average of 30%
  - Interior space-by-space reduced an average of 26%
  - Decorative & Retail display reduced ~25%

Lighting

- Exterior lighting and parking garage lighting controls
  - Reduce power by 50% (was 30%) during unoccupied periods or after business hours
  - Some outdoor parking areas automatically reduce by at least 50% as detected by occupancy sensors

Impact	90.1	IECC
$$	✓	Not In

Lighting

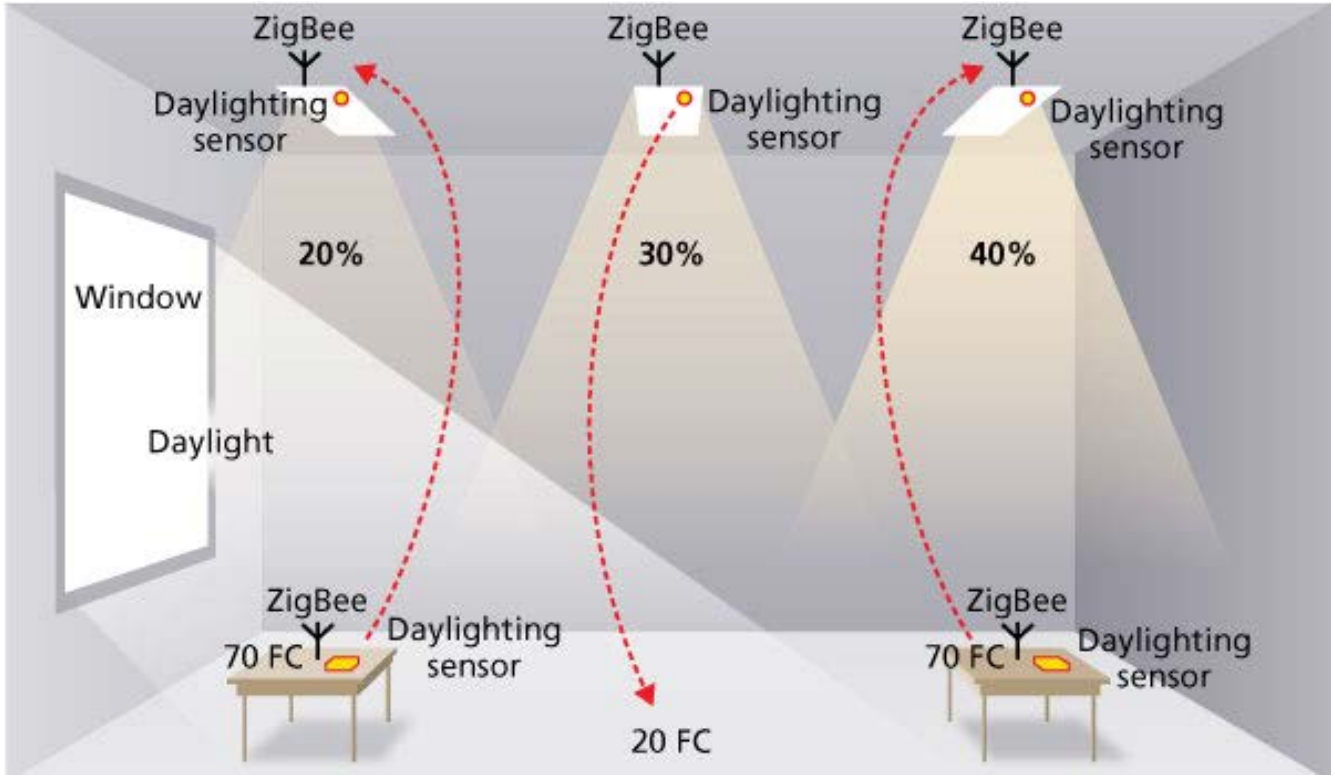
- Open office areas now require occupancy sensors
  - Simple control of lighting fixtures by occupancy sensor
  - Advanced layered lighting control system

Impact	90.1	IECC
$$$	Not In	✓

Lighting

Impact	90.1	IECC
$	Not In	✓

- Daylighting control tradeoff
  - New buildings with ≤ 30% window-to-wall ratio
  - Trade off 40% reduction in LPD vs. ~30% daylight savings

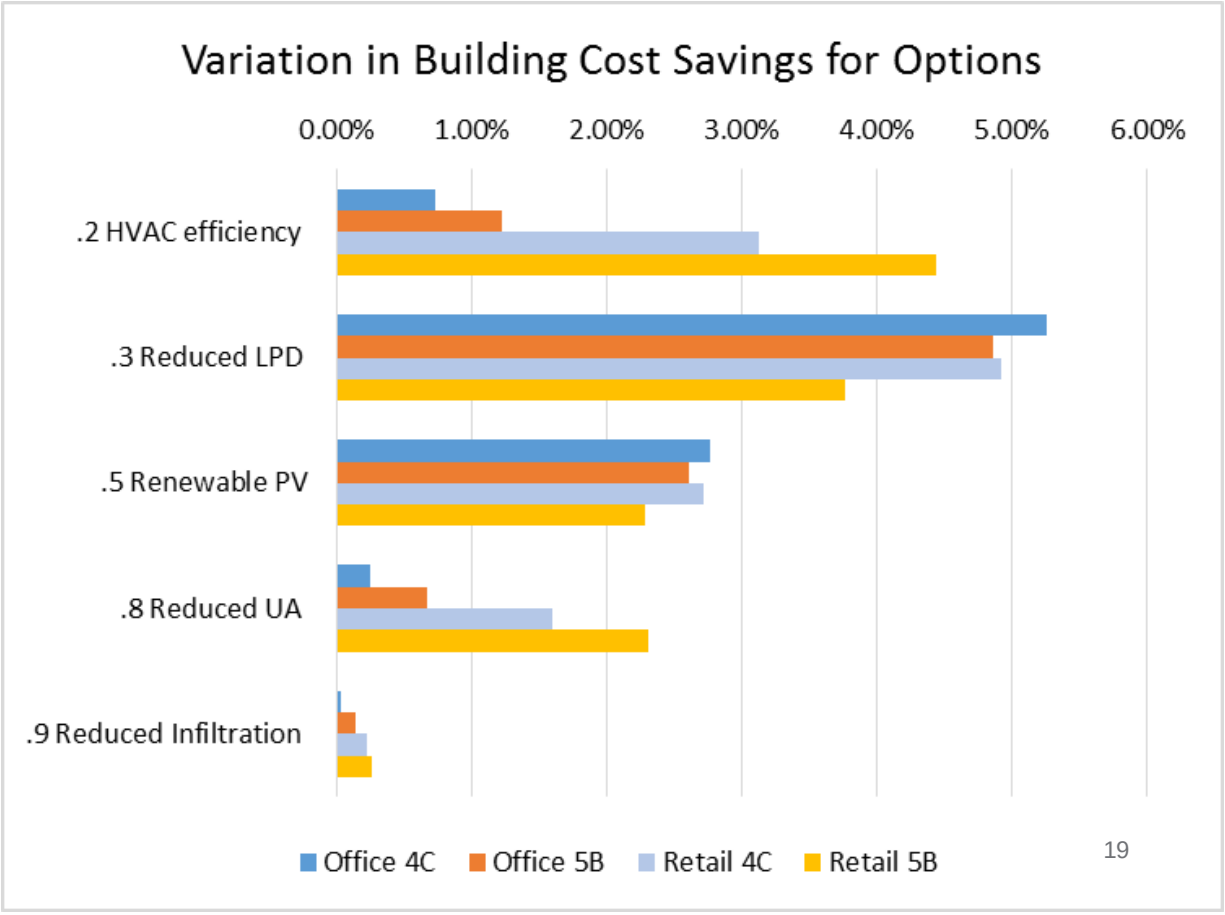


Added Efficiency Measures

- Section 406 Added Efficiency measure choices expanded
  - Residential lamp efficacy for MF
  - Tested air barrier at 0.25 cfm/ sq ft
  - 15% UA reduction

Impact	90.1	IECC
N/A	Not In	✓

- Former choices
  - HVAC
  - LPD reduction
  - Renewable
  - Light Ctrl
  - DOAS
  - Hi Eff SWH
- How five options compare (Office & Retail in climate zones 4C & 5B)

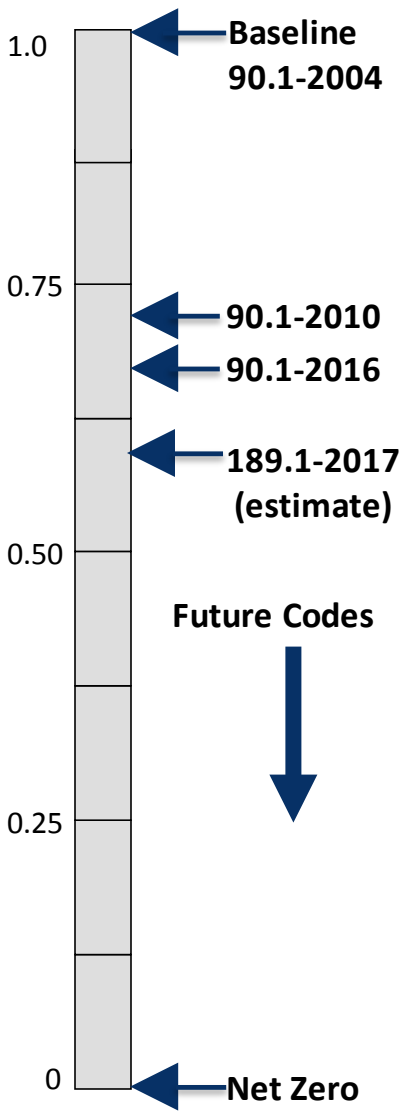


New Compliance Path: Appendix G

- Both codes have prescriptive/performance paths
  - 90.1-2016 Introduces a Third Path for Compliance
  - Appendix G requires a Performance Cost Index (PCI) specific to building type and climate zone

$$Performance\ Cost\ Index\ (PCI) = \frac{Proposed\ Building\ Performance}{Baseline\ Building\ Performance}$$

- Stable and independent baseline set ~ 90.1-2004
  - Intent is that the stringency of the baseline doesn't change (stable)
  - Clear rules about what systems and other prescriptive choices are in baseline (independent)
- PCI target changes with each version of a code
  - Each code edition has a required PCI for compliance
  - Beyond code programs can choose a PCI to meet their needs



New Compliance Path: Appendix G

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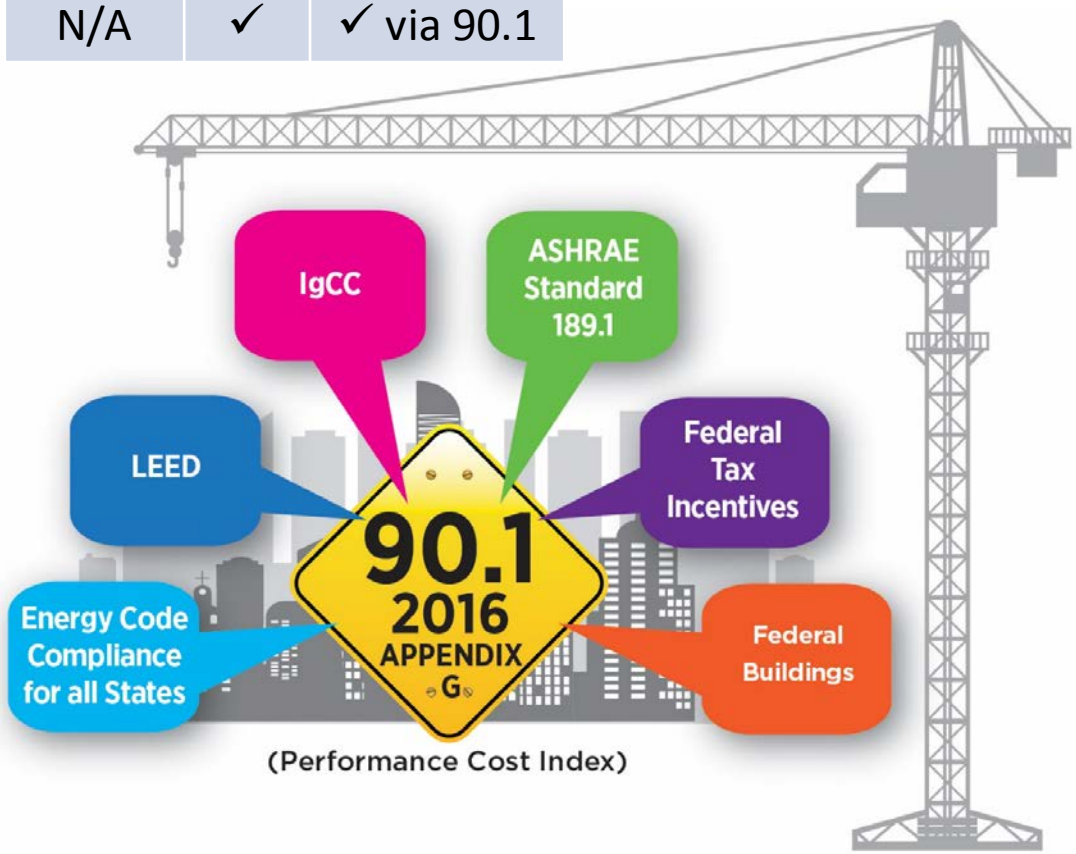
- 90.1 Appendix G - Single Ruleset for Many Purposes
- 90.1-2016 Introduces a Third Path for Compliance

Impact	90.1	IECC
N/A	✓	✓ via 90.1



- Increases flexibility
- Reduces modeling costs
- Stability encourages creating software to automate performance modeling
- Provides credit for good design practices that were previously not recognized for code compliance
  - Good HVAC systems
  - Right sizing of HVAC
  - Optimized orientation
  - Thermal mass

New Compliance Path: Appendix G

- Clear modeling rules for baseline & proposed

Table G3.1 Modeling Requirements for Calculating Proposed and *Baseline Building Performance* (Continued)

No.	*Proposed Building Performance*	*Baseline Building Performance*
4. Schedule		
	Schedules capable of modeling hourly variations in occupancy, lighting power, miscellaneous *equipment* power, *thermostat set points*, and *HVAC system* operation shall be used. The schedules shall be typical of the proposed *building* type as determined by the designer and approved by the *rating authority*. **Temperature and Humidity Schedules.** Temperature and humidity *control set points* and schedules as well as *temperature control throttling range* shall be the same for *proposed design* and *baseline building design*. **HVAC Fan Schedules.** Schedules for HVAC fans that provide *outdoor air* for *ventilation* shall run continuously whenever spaces are occupied and shall be cycled ON and OFF to meet	Same as *proposed design*. **Exceptions:** 1. *Set points* and schedules for *HVAC systems* that automatically provide occupant thermal comfort via means other than directly controlling the air dry-bulb and wet-bulb temperature may be allowed to differ, provided that equivalent levels of occupant thermal comfort are demonstrated via the methodology in ASHRAE Standard 55, Section 5.3.3, "Elevated Air Speed," or Standard 55, Appendix B, "Computer Program for Calculation of PMV-PPD." 2. Schedules may be allowed to differ between *proposed design* and *baseline building design* when necessary to model nonstandard *efficiency* measures, provided

Table G3.1.2.6 Climate Conditions under which Economizers are Included for Comfort Cooling for Baseline *Systems* 3 through 8 and 11, 12, and 13

Climate Zone	Conditions
0A, 0B, 1A, 1B, 2A, 3A, 4A	NR
Others	Economizer Included

Note: NR means that there is no conditioned *building floor* area for which economizers are included for the type of zone and climate.

Table G3.5.1 *Performance Rating Method* Air Conditioners

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum *Efficiency*
Air conditioners, air-cooled	<65,000 Btu/h	All	Single-package	9.7 *SEER*
	≥65,000 Btu/h and <135,000 Btu/h		Split-*system* and single-package	10.1 *EER*
	≥135,000 Btu/h and <240,000 Btu/h			9.5 *EER*

- Targets for improvement by building type and climate zone (PCI)

$$Performance\ Cost\ Index\ (PCI) = \frac{Proposed\ Building\ Performance}{Baseline\ Building\ Performance}$$

Baseline building roughly equivalent to 90.1-2004

Table 4.2.1.1 *Building* Performance Factor (BPF)

Building Area Type[a]	Climate Zone																
	0A and 1A	0B and 1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Multifamily	0.73	0.73	0.71	0.69	0.74	0.73	0.68	0.78	0.81	0.81	0.76	0.80	0.81	0.76	0.79	0.74	0.80
Healthcare/ hospital	0.64	0.56	0.60	0.56	0.60	0.56	0.54	0.57	0.53	0.55	0.59	0.52	0.55	0.57	0.52	0.56	0.56
Hotel/motel	0.64	0.65	0.62	0.60	0.63	0.65	0.64	0.62	0.64	0.62	0.60	0.61	0.60	0.59	0.61	0.57	0.58
Office	0.58	0.62	0.57	0.62	0.60	0.64	0.54	0.58	0.60	0.58	0.60	0.61	0.58	0.61	0.61	0.57	0.61
Restaurant	0.62	0.62	0.58	0.61	0.60	0.60	0.61	0.58	0.55	0.60	0.62	0.58	0.60	0.63	0.60	0.65	0.68
Retail	0.52	0.58	0.53	0.58	0.54	0.62	0.60	0.55	0.60	0.60	0.55	0.59	0.61	0.55	0.58	0.53	0.53
School	0.46	0.53	0.47	0.53	0.49	0.52	0.50	0.49	0.50	0.49	0.50	0.50	0.50	0.49	0.50	0.47	0.51
Warehouse	0.51	0.52	0.56	0.58	0.57	0.59	0.63	0.58	0.60	0.63	0.60	0.61	0.65	0.66	0.66	0.67	0.67
All others	0.62	0.61	0.55	0.57	0.56	0.61	0.59	0.58	0.57	0.61	0.57	0.57	0.61	0.56	0.56	0.53	0.52

a. In cases where both a general *building* area type and a specific *building* area type are listed, the specific *building* area type shall apply

New Performance Path Summary

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- 90.1-2016 Introduces a Third Path for Compliance
  - Provides increased flexibility
  - Saves time and money dedicated to energy modeling by allowing a single modeling approach to be used for multiple functions
  - Encourages the creation of tools that automate the simulation process as the market is increased
  - Provides credit for good design practices that were previously not recognized for code compliance

Other Changes with Large Energy Savings

- 2018 IECC Changes
  - Reorganize fan sections; avoid dropped requirements on smaller fans
  - Limits temperature setpoints in conditioned vestibules
  - Shut-off damper clarification
  - DOAS ventilation air heating control limit to 60F when building is cooling
  - Clarify fan pressure drop for power limit
  - Changing one value in fan pressure drop table for power limit
  - Lowers variable fan threshold from 7.5 to 5 HP
  - Removes VAV ventilation optimization exception for exhaust ERV
  - Clarifies that parallel VAV fan box control shall minimize fan use
  - Occupancy sensor timeout reduction
  - Reduce retail extra lighting by 40%/25%
  - Reduce decorative extra lighting by 10% in lobbies & 25% elsewhere

Other Changes with Large Energy Savings

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- 90.1-2016 Changes *(grey text is same change as IECC)*
  - Increase stringency of fenestration orientation requirements
  - Limits temperature setpoints in conditioned vestibules
  - Ductwork insulation requirements increase
  - DOAS ventilation air heating control limit to 60F when building is cooling
  - If more than 135% or required 62.1 ventilation, ERV required
  - Lowers variable fan threshold from 7.5 to 5 HP
  - Removes VAV ventilation optimization exception for exhaust ERV
  - Broader application of transfer air requirements
  - Minimum cooling coil selection temperature difference; saves pumping
  - Clarifies that parallel VAV fan box control shall minimize fan use

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Savings Potential from Model Energy Codes

Model Codes Historic Savings

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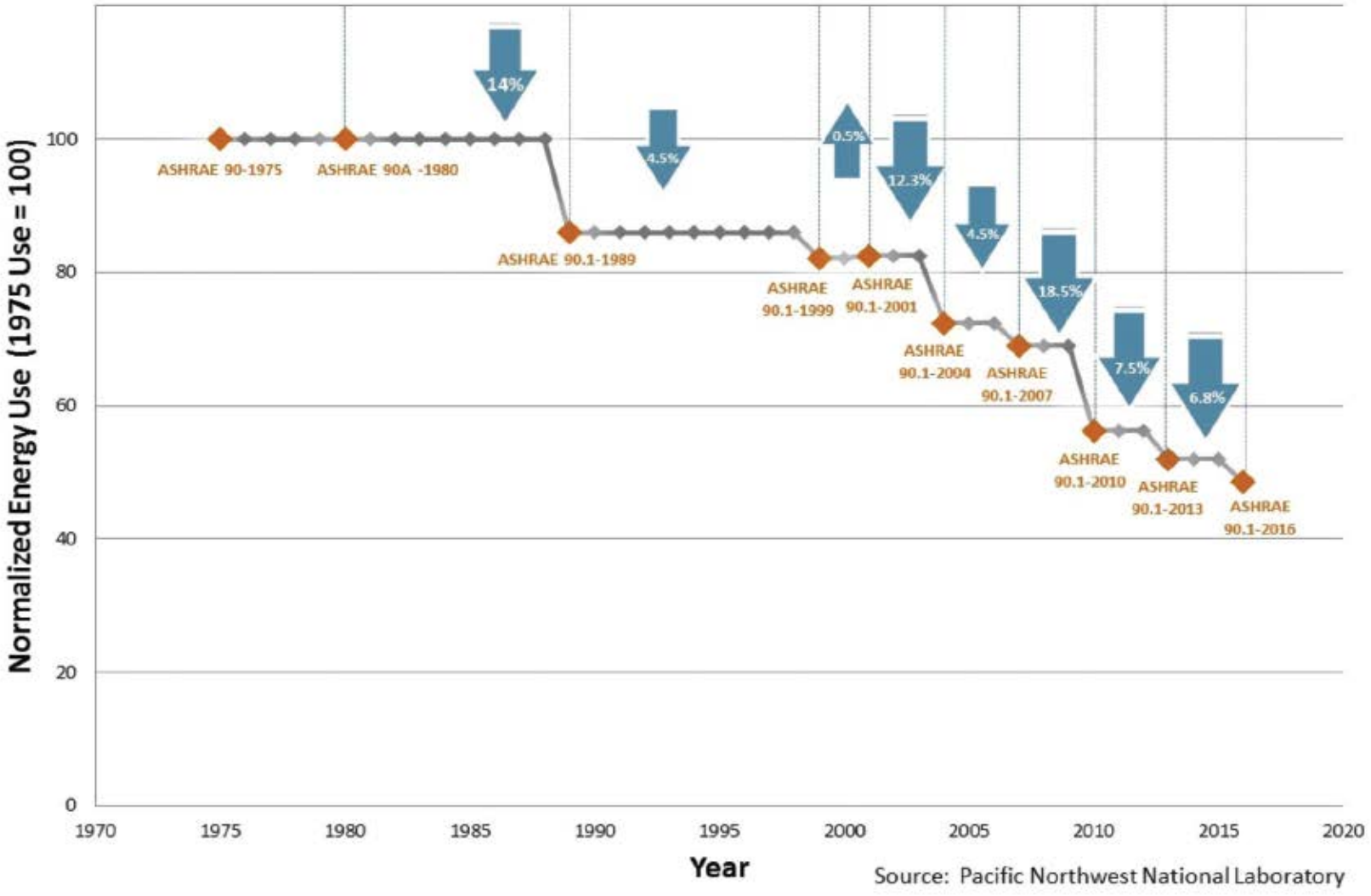
Improvements in ASHRAE Standard 90.1 (Year 1975-2016)



Source: Pacific Northwest National Laboratory

Energy Saving Analysis Method

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Develop 16 prototype building models in 90.1 consensus process with EnergyPlus

Generate minimally code-compliant models for 90.1-2004, 2007, 2010, 2013 and 2016 editions

Simulate the 16 buildings for 5 code editions in 17 climate zones

Assign new building construction weighting factor to each building in each climate zone

Calculate the national weighted energy use intensity and energy cost index

90.1-2016 Energy Savings

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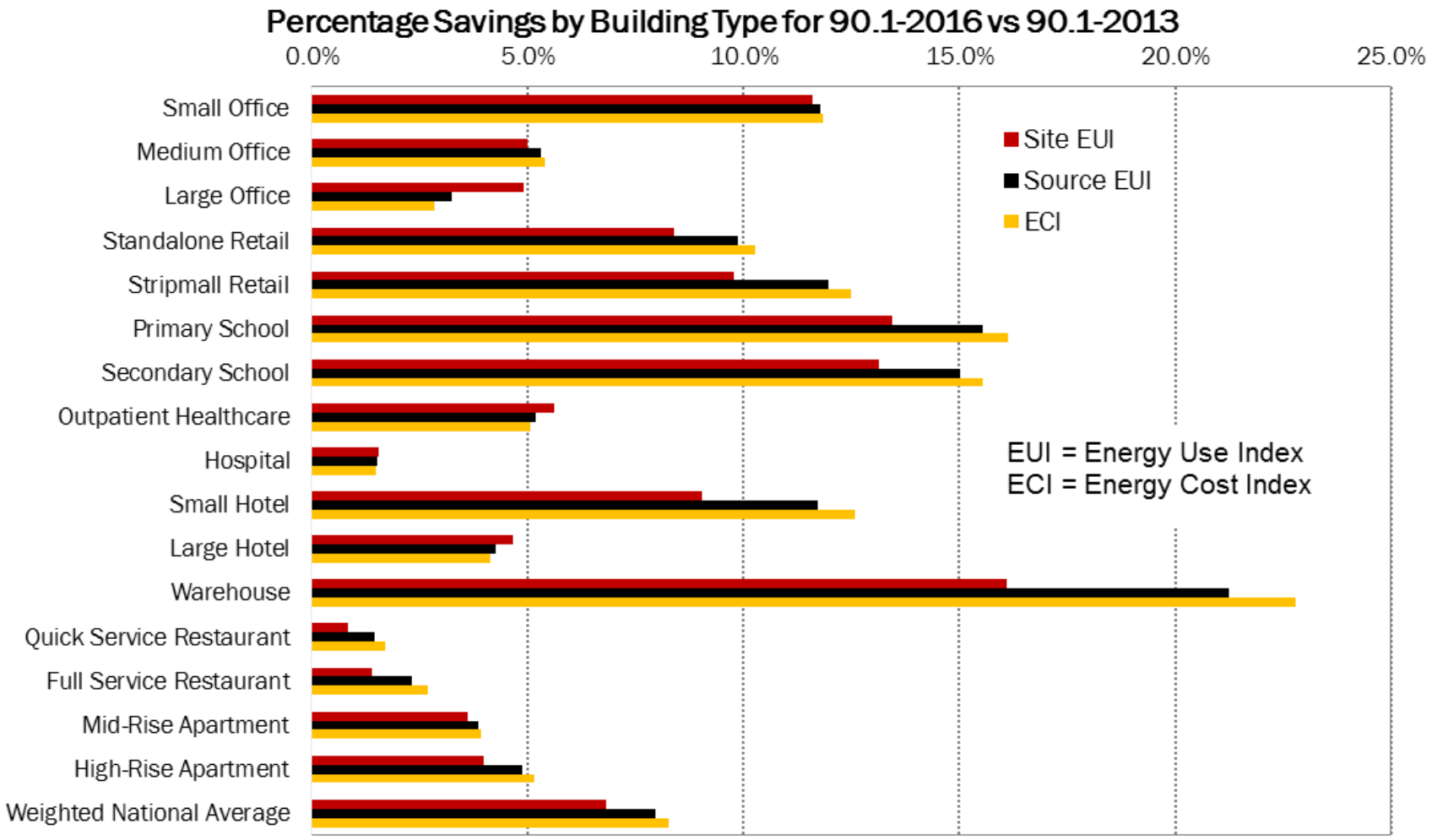

Note: Determination results do not include appliance efficiency improvements.

Overall Results

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New commercial buildings meeting the requirements of Standard 90.1-2016 that were analyzed in the Quantitative Analysis exhibit national savings of approximately (compared to Standard 90.1-2013):

- 8.3 percent energy cost savings
- 7.9 percent source energy savings
- 6.8 percent site energy savings

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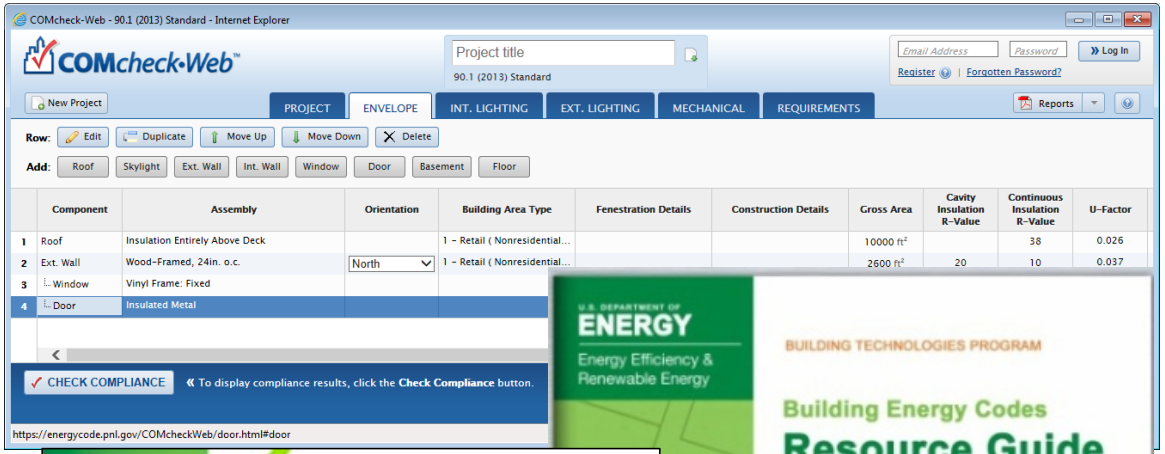
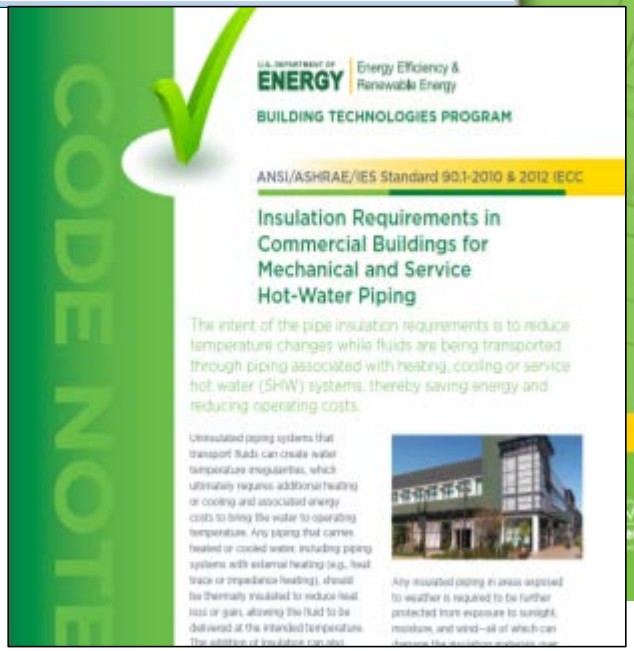
Energy Code Resources

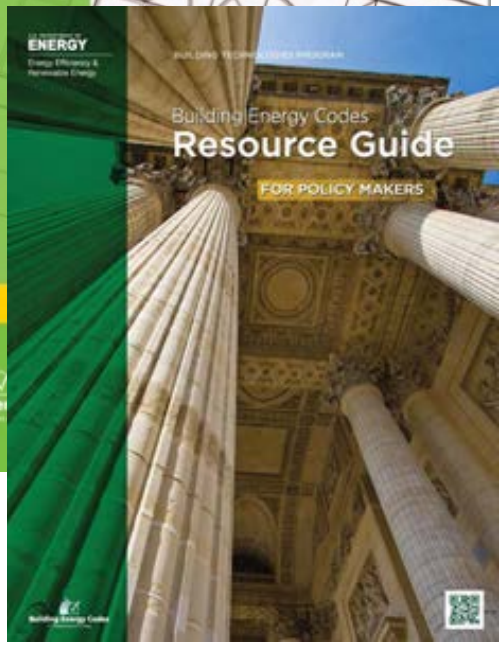
U.S. DOE: BECP Resources

- Compliance software
- Technical support
- Code notes
- Publications
- Resource guides
- Training materials

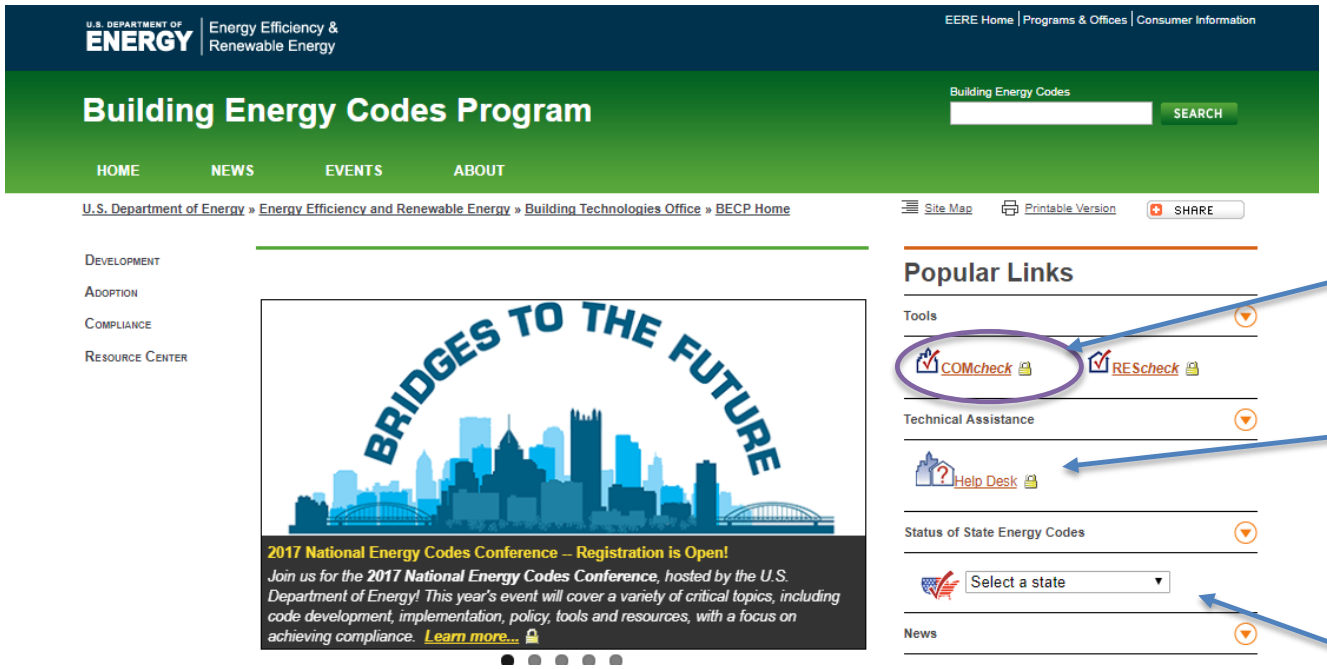
www.energycodes.gov







www.energycodes.gov



COMcheck for code compliance forms

Help Desk available for specific code questions

Links to State resources

- After selecting COMcheck choose either
  - Desktop download for Windows
  - COMcheck web online

COMcheck Compliance Methods

Building System

- Envelope
- HVAC
- SWH
- Power
- Lighting
- Other

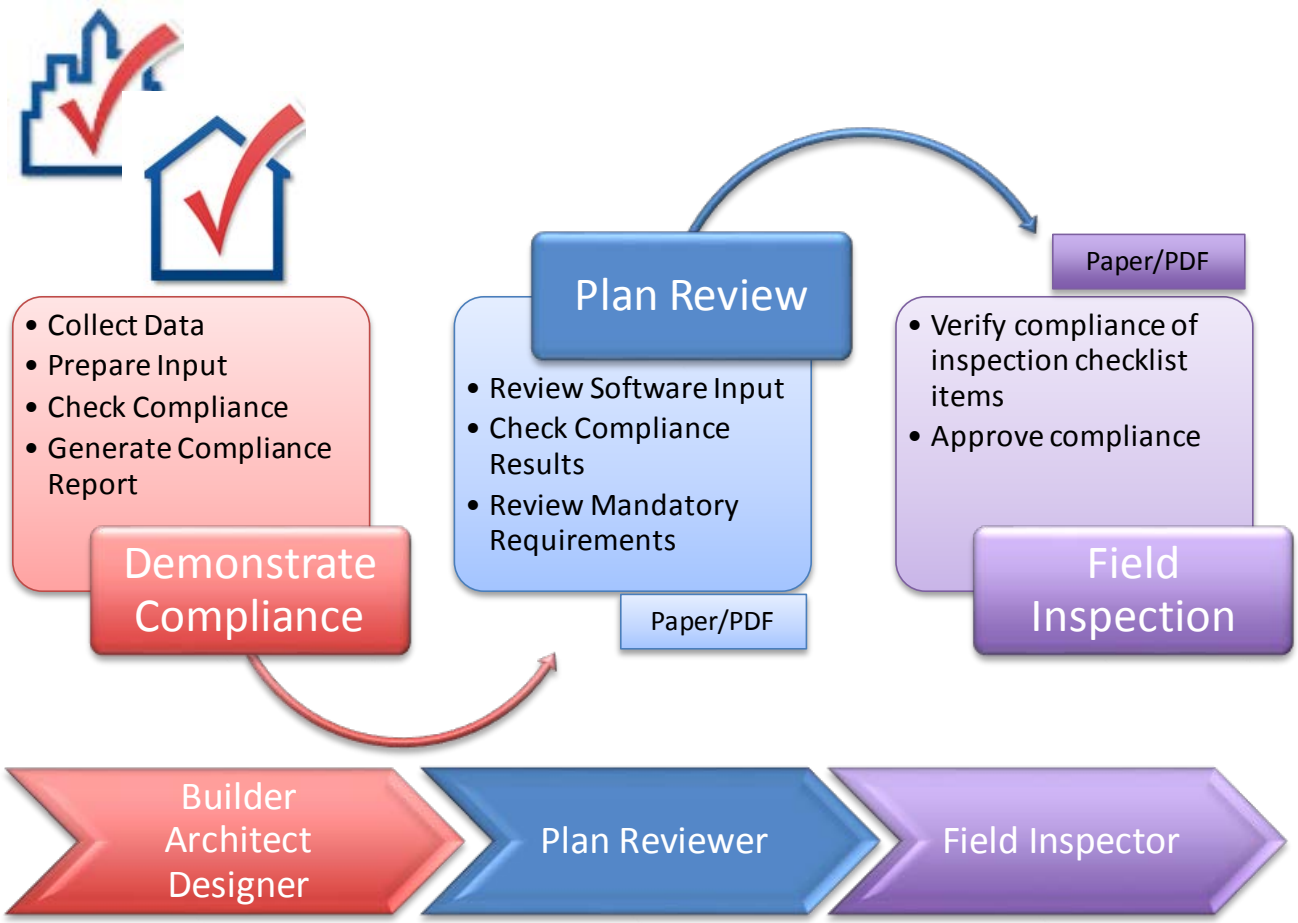
Mandatory Provisions
(required for most compliance options)

Compliance Options

- Prescriptive Option
- Trade Off Option
- Energy Cost Budget & Appendix G: Performance Simulation

Energy Code Compliance

CheckTools Current Use Scenario



BECP Tools used only during “Demonstrate Compliance” Stage
COMcheck for 90.1-2016 now; for 2018 IECC in June 2018

THANK YOU!

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Building Energy Codes Program

www.energycodes.gov

BECP help desk

http://www.energycodes.gov/resource-center/help-desk

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Discussion & Questions

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