



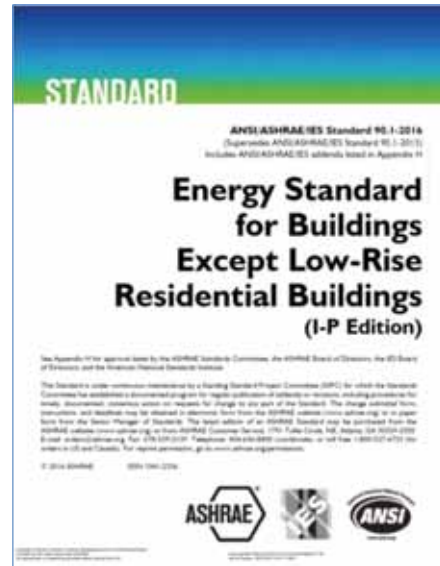
# Update to ASHRAE Standard 90.1-2016

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Whole Building Systems, LLC

July 19, 2017

- ▶ Standard 90.1 Goals
- ▶ Major Changes in 90.1-2016
- ▶ Energy Savings Impact of Standard 90.1-2016



1. Provide an overview of the major requirements of the 90.1-2016 Standard that are of interest to engineers, designers, architects, contractors and policy makers.
2. Understand the significant changes in the Envelope, Mechanical, Lighting Sections, and Performance Compliance Path sections of Standard 90.1-2016 versus the 2013 edition.
3. Provide insights into appropriate application of the major new requirements.
4. Receive a better understanding of the design changes needed to meet the new requirements.

# Standard 90.1 Goals

## ▶ Standard 90.1 Overall Goal

- ANSI consensus standard
- Save energy
- Technically feasible and cost effective

## ▶ 90.1-2016 Specific Goals

- Easy to use
- New format to move to e-reading
- Improvement measured by whole building energy performance

## Summary of Changes

- ▶ Total of 121 addenda
- ▶ Major format changes for ease of use
- ▶ New climate maps aligning with ASHRAE Standard 169
- ▶ New performance-based compliance path
- ▶ Significant whole building energy savings

Major format changes include:

- 1. 1 column format for easier reading
- Exceptions separated, indented and set apart with a smaller font size
- Defined terms are Italicized
- Alternating coloring scheme for table rows

# New Format

## 2013

- 278 total pages
- Two-column format
- No shading for table rows
- Defined terms normal font



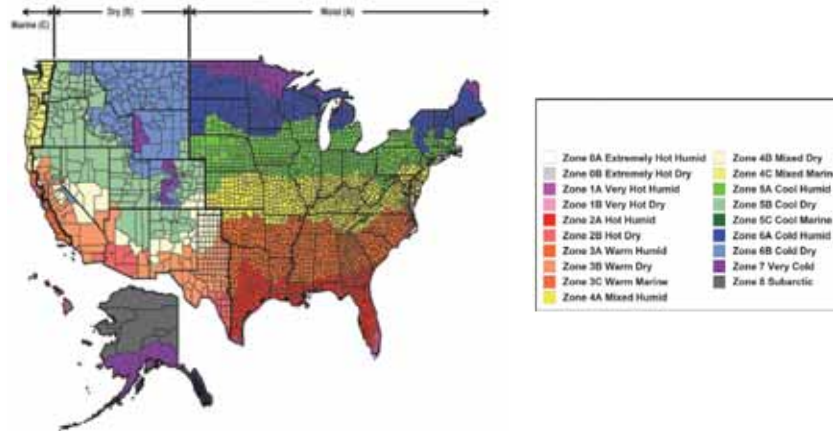
## 2016

- 388 total pages
- Single-column format
- Alternate shading for table rows
- Defined terms italicized



# New 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 U.S. counties reassigned to a warmer climate zone



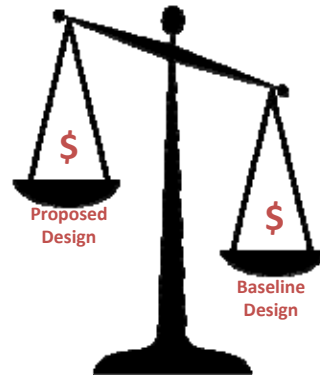
# Prescriptive Changes

- ▶ Standard 90.1 includes two types of compliance paths

## Prescriptive path

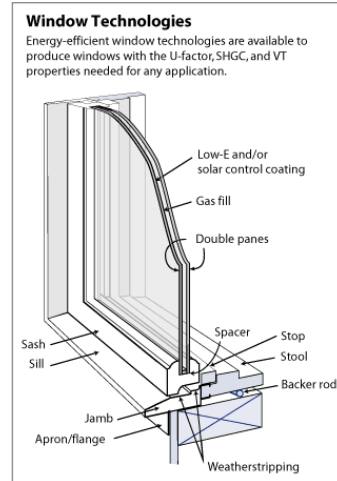


## Performance Path



## ► Fenestration

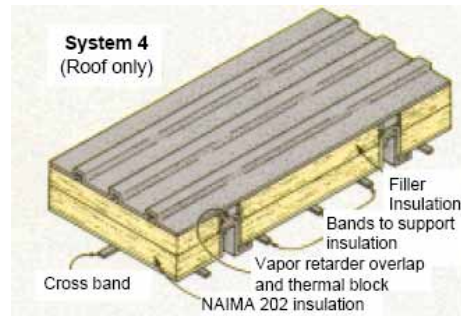
- 90.1-2016 includes a comprehensive update to the fenestration prescriptive requirements
  - U-factor reduced by as much as 22% in some climate zones
  - SHGC reduced by as much as 12%





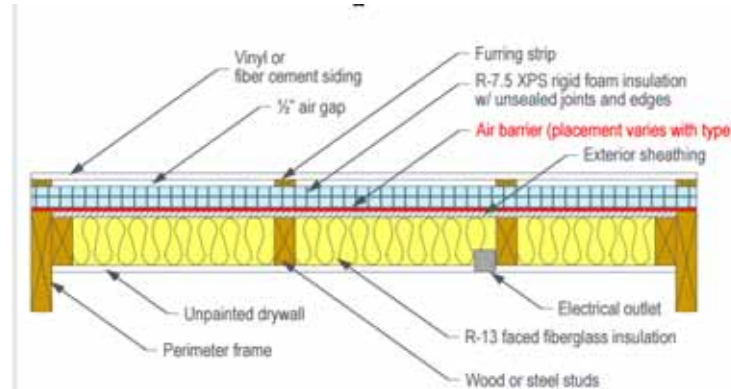
## ► Walls and Doors

- Metal building wall thermal properties better defined to enhance compliance
- U-factors and air leakage limits for doors are improved



## ► Building Air Leakage

- Whole building air leakage testing added as a compliance option
- Air barrier design and installation verification required



## ► Increased HVAC Equipment Efficiency Requirements



Chillers



Heat Pumps



Computer Room AC



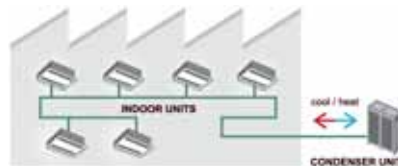
Dedicated Outdoor Air\*



Rooftop AC Units



Cooling Towers



Variable Refrigerant Flow

\* Newly regulated equipment

- ▶ Replacement equipment now needs to meet many of the requirements formerly for new equipment only.  
For example:

- Various controls requirements
- Economizer requirements
- Fan efficiency
- Boiler turndown



# Mechanical

- ▶ Hotel/Motel Guest Room Controls
  - Heating, cooling, & ventilation automatically reduced when unoccupied
- ▶ Chilled Water Plant Metering
  - Large plants required to meter for electricity and efficiency
- ▶ Economizer Fault Detection and Diagnostics
  - Ensures that economizers using outdoor air for free cooling are configured and working correctly



- ▶ Reduced Lighting Power Allowance – Exterior, Interior, Retail Display
  - 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%
  - Retail display reduced ~25%



- ▶ Exterior lighting and parking garage lighting requirements to reduce power by 50% during unoccupied periods or after business hours
  - Increased from 30%



- ▶ Parking areas with shorter poles (24 ft or less) & > 78W
  - Lights automatically reduce by at least 50% as detected by occupancy sensors





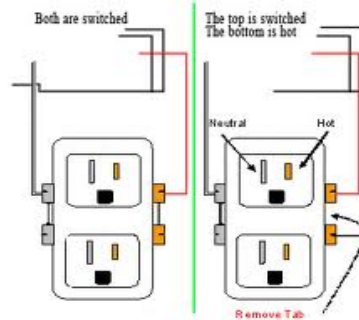
## ▶ Dwelling Unit Lighting

- Apartments, condos, living space must have at least 75% of permanently installed fixtures with minimum lamp efficacy of 55 lumens/Watt
- Likely requires LED or fluorescent



▶ 50% of receptacles (wall plugs) in a space must have automatic shutoff control

- Private offices, conference rooms, print/copy, breakroom, classroom individual workstations
- Requires automatic control (ex: occupancy sensor or time-of-day schedule)
- Controlled receptacles must be marked and uniformly distributed
- **Plug-in type devices do not comply**



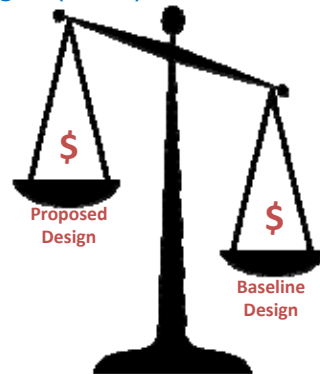
# New Compliance Path

► 90.1-2013 Includes Two Paths for Compliance:

## Prescriptive



## Performance – Energy Cost Budget (ECB)



# New Compliance Path

- ▶ 90.1-2016 Introduces a Third Path for Compliance
  - Appendix G, Performance Rating Method – similar to Energy Cost Budget but more flexible
  - Not for code compliance (prior to 2016)
  - Used for beyond code programs
    - LEED
    - ASHRAE Standard 189.1
    - International Green Construction Code (IgCC)
    - EPACT Tax Credits
  - Provides credit for good design choices typically not recognized in code
    - Good HVAC systems selection
    - Right sizing of HVAC systems
    - Optimized orientation and use of windows
    - Efficient use of thermal mass

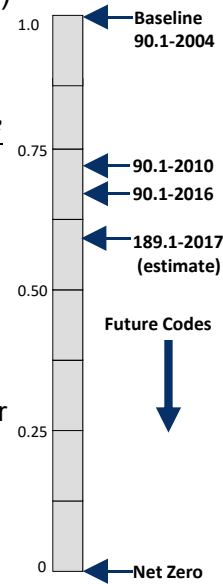
# New Compliance Path

- ▶ Appendix G requires a Performance Cost Index (PCI) specific to building type and climate zone

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

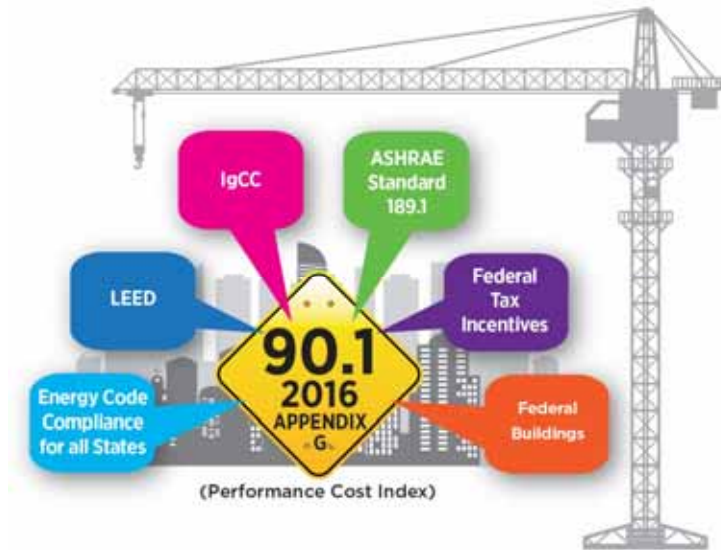
- ▶ Baseline set ~ 90.1-2004

- Intent is that the stringency of the baseline doesn't change
- PCI target changes with each version of a code
- Beyond code programs can choose a PCI to meet their needs



# New Compliance Path

## ► Appendix G - Single Ruleset for Many Purposes

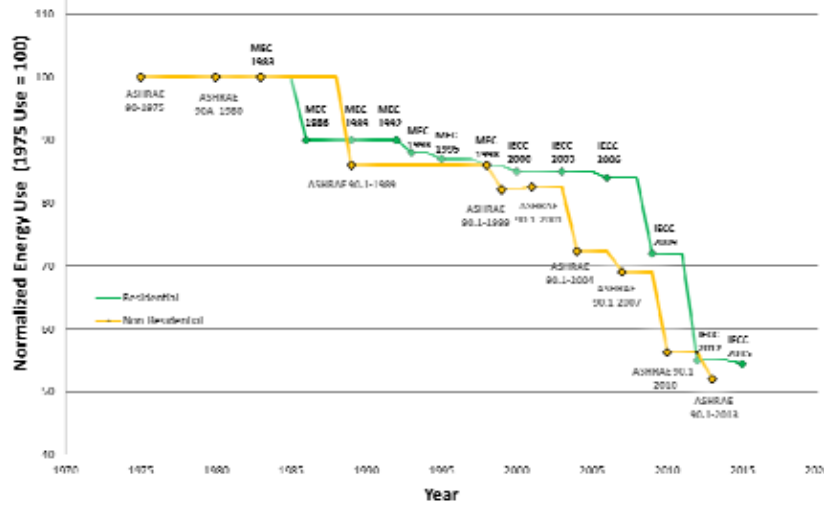


# New Performance Path Summary

- ▶ 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

# Model Codes Historic Savings

Improvement in Residential and Non-Residential Model Energy Codes (Year 1975-2015)  
Courtesy of Pacific Northwest National Laboratory



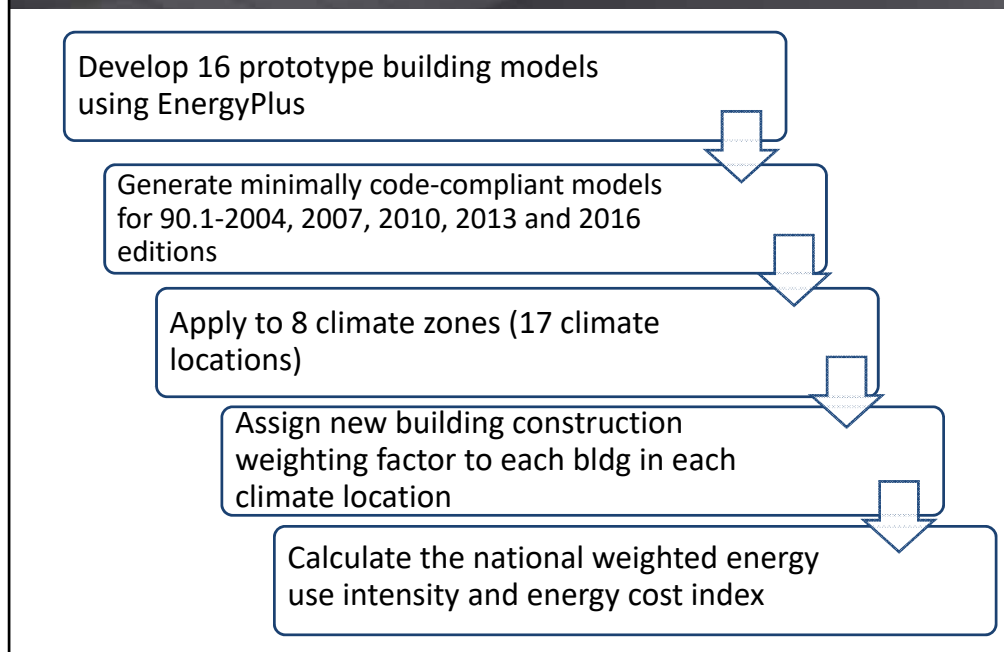
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- Savings from the energy codes are derived from DOE's Determination
- Savings achieved through appliance standards are excluded to avoid double-counting
- Savings from other market forces are excluded in the code impact analysis



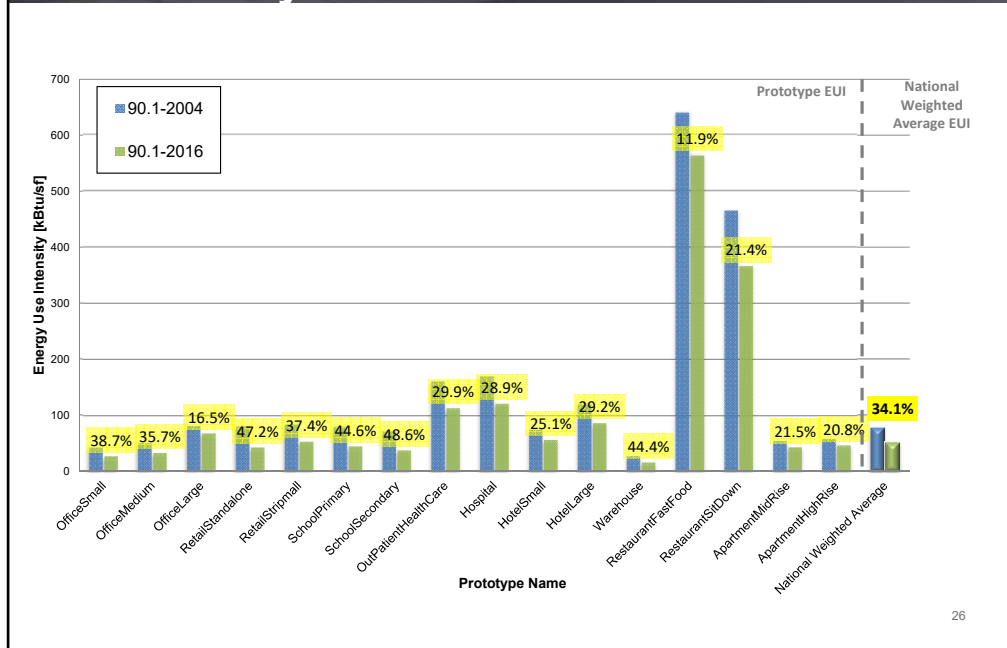
# Energy Saving Analysis Method

Pacific Northwest  
NATIONAL LABORATORY  
Proudly Operated by Battelle Since 1965



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# 90.1-2016 Energy Savings Preliminary Results



- Savings from the energy codes are derived from DOE’s Determination
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- Savings from other market forces are excluded in the code impact analysis

# Preliminary Results

National Weighted Average	Site Energy [kBtu / ft <sup>2</sup> -yr] Energy Cost [\$ / ft <sup>2</sup> -yr]			% Energy or Cost Savings		
	90.1-2004	90.1-2013	90.1-2016 PI	90.1-2013 vs. 90.1-2004	90.1-2016 PI vs. 90.1-2004	90.1-2016 PI vs. 90.1-2013
Whole Building	76.5	54.1	50.43	29.3%	34.1%	6.8%
	\$1.84	\$1.32	\$1.21	28.5%	34.2%	8.0%

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# Discussion

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