



U.S. Department of Energy  
Energy Efficiency and Renewable Energy



Building Energy Codes

# What Does 30% Better than Standard 90.1-2004 Look Like?

Mark Halverson

Pacific Northwest National Laboratory

## ASHRAE's Goal

- Standard 90.1-2010 should be 30% more energy efficient than Standard 90.1-2004
- What does this mean to you?

- No one knows YET
- Standard 90.1-2007 provides some savings but it is not indicative of what Standard 90.1-2010 may look like
- Standard 90.1-2010 is still under development
- However, ASHRAE Advanced Energy Design Guides are available for purchase
- And ASHRAE Standard 189P provides one possible glimpse

## Possible Examples (in order of increasing stringency)

- **ASHRAE Standard 90.1-2004/2006 IECC**
- **ASHRAE Standard 90.1-2007**
- NBI Advanced Buildings Benchmark
- **ASHRAE Advanced Energy Design Guides for Small Office and Small Retail**
- DOD Prescriptive Requirements that meet new Federal Standards
- **ASHRAE Standard 189P**
  
- We'll look at those in **bold** font.

## Estimated Stringency (compared to ASHRAE Standard 90.1-2004)

- Less than 10%
  - **2006 IECC**
  - **ASHRAE Standard 90.1-2007**
- About 20%
  - NBI Advanced Buildings Benchmark
  - **ASHRAE Advanced Energy Design Guides for Small Office and Small Retail**
- About 30%
  - DOD Prescriptive Requirements that meet new Federal Standards
  - **ASHRAE Standard 189P**

## Example Building

- Two story office building
- Pittsburgh, Pennsylvania (Zone 5)
- 20,000 ft<sup>2</sup>
- 2:1 aspect ratio (70.7 ft x 141.4 ft)
- 12 ft floor to floor height
- 30% Glazing equally distributed on all sides
- Metal frame windows
- Built-Up roof
- Steel frame walls
- Slab floor
- Multiple 7.5 ton packaged rooftop units with gas heat
- Gas Water Heater

- All requirements shown are mandatory or prescriptive requirements from standards or codes or requirements from guidelines
- Prescriptive requirements can be traded off using system performance or whole building tradeoff methods

## Standard 90.1-2004 Requirements

- Standard 90.1-2004 Mandatory requirements
- Heating Efficiency – 80%  $E_c$
- Cooling Efficiency – 10.3 EER
- No Economizer
- SWH Efficiency – 80%  $E_t$  minimum
- R-15 ci Roof Insulation
- R-13 + R-3.8 ci wall insulation
- No slab insulation
- Window U-0.57
- Window SHGC-0.39
- Lighting Power Density – 1.0 w/ft<sup>2</sup>

## Differences from Standard 90.1-2004

- Increase in stringency shown in green font
- Decreases in stringency shown in red font
- Measures required or recommended but not included in energy savings are in grey font

## 2006 IECC Requirements

- Standard 90.1-2004 Mandatory requirements
- Heating Efficiency – 80%  $E_c$
- Cooling Efficiency – 9.9 EER
- No Economizer
- SWH Efficiency – 80%  $E_t$
- R-20 ci Roof Insulation
- R-13 + R-3.8 ci wall insulation
- No slab insulation
- Window U-0.55
- Window SHGC-0.40
- Lighting Power Density – 1.0 w/ft<sup>2</sup>

## Standard 90.1-2007 Requirements

- Standard 90.1-2004 Mandatory requirements
- Heating Efficiency – 80%  $E_c$
- Cooling Efficiency – 11.2 EER
- Economizer Required
- SWH Efficiency – 80%  $E_t$
- R- 15 ci Roof Insulation
- R-13 + R-7.5 ci wall insulation
- No slab insulation
- Window U-0.55
- Window SHGC-0.40
- Lighting Power Density – 1.0 w/ft<sup>2</sup>

## AEDG-Small Office Requirements

- Standard 90.1-1999 (not 2004) Mandatory requirements
- Heating Efficiency – 80%  $E_c$
- Cooling Efficiency – 11.0 EER/11.4 IPLV
- Economizer Required
- SWH Efficiency – 90%  $E_t$
- PLUS See Next Slide
- R-20 ci Roof Insulation
- R-13 + R-7.5 ci wall insulation
- No slab insulation
- Window U-0.42
- Window SHGC-0.46
- Lighting Power Density – 0.9 w/ft<sup>2</sup>

## AEDG-Small Office Requirements **PLUS**

- Required overhang for S, E, W with  $PF=0.5$
- Required window Orientation
- Required daylighting and occupancy controls
- Required room surface reflectance
- Required outdoor air motorized dampers
- Required CO2 demand controlled ventilation
- Lower duct friction rate
- Ducts in interior space
- More SWH pipe insulation

# ASHRAE Standard 189P Requirements

- Standard 90.1-2004 Mandatory requirements
- Heating Efficiency – 81%  $E_t$
- Cooling Efficiency – 11.2 EER
- Economizer Required
- SWH Efficiency – 80%  $E_t$
- PLUS See Next Slide
- R-25 ci Roof Insulation
- R-13 + R-10.0 ci wall insulation
- R-10 for 24” slab insulation
- Window U-0.45  
Window SHGC-0.35
- Lighting Power Density – 0.9 w/ft<sup>2</sup>

# ASHRAE Standard 189P Requirements **PLUS**

- Required window overhangs for S, E, W with PF=0.5
- Required window orientation
- Continuous air barrier
- Required daylighting and occupancy controls
- Required room surface reflectance
- Required cool roof
- Onsite renewable energy power system for 2% of load (1% if design has high efficiency HVAC equipment)
- Energy metering
- Required outdoor air motorized dampers
- Demand controlled ventilation
- Lowered fan power limitation
- Higher level of duct sealing
- More duct insulation
- More SWH pipe insulation
- Energy Star equipment and appliances
- Higher motor and transformer efficiency
- SWH consumption reduction and heat recovery
- Demand limiting or load shifting system

## Another Way to Look at Improvements

- Instead of having each standard, code, or guide on one or more slides, put them all on one slide
- One additional slide covers the additional requirements of the AEDG-Small Office and ASHRAE Standard 189P

	90.1-2004	2006 IECC	90.1-2007	AEDG-Small Office	189P
Mandatory	90.1-2004	90.1-2004	90.1-2004?	90.1-1999	90.1-2004
Heating Efficiency	80% E <sub>c</sub>	80% E <sub>c</sub>	80% E <sub>c</sub>	80% E <sub>c</sub>	81% E <sub>c</sub>
Cooling Efficiency	10.3 EER	9.9 EER	11.2 EER	11.0 EER/ 11.4 IPLV	11.2 EER
Economizer	NR	NR	Yes	Yes	Yes
SWH Efficiency	80% E <sub>t</sub>	80% E <sub>t</sub>	80% E <sub>t</sub>	90% E <sub>t</sub>	80% E <sub>t</sub>
Roof Insulation	R-15 ci	R-20 ci	R-15 ci	R-20 ci	R-25 ci
Wall Insulation	R-13 + R-3.8 ci	R-13 + R-3.8 ci	R-13 + R-7.5 ci	R-13 + R-7.5 ci	R-13 + R-10.0 ci
Slab Insulation	NR	NR	NR	NR	R-10 for 24"
Window U-Factor	0.57	0.55	0.55	0.42	0.45
Window SHGC	0.39	0.40	0.40	0.46	0.35
LPD	1.0 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup>	1.0 W/ft <sup>2</sup>	0.9 W/ft <sup>2</sup>	0.9 W/ft <sup>2</sup>

PLUS

PLUS

## AEDG – Small Office

- Required overhang for S, E, W with PF=0.5
- Required window Orientation
- Required daylighting and occupancy controls
- Required outdoor air motorized dampers
- Required CO2 demand controlled ventilation
- Lower duct friction rate
- Required room surface reflectance
- Ducts in interior space
- More SWH pipe insulation

## Standard 189P

Everything from AEDG-Small Office **and**

- Continuous air barrier
- Required cool roof
- Demand controlled ventilation
- Higher motor and transformer efficiency
- SWH consumption reduction and heat recovery
- Onsite renewable energy power system
- Energy metering
- Lowered fan power limitation
- Higher level of duct sealing
- More duct insulation
- More SWH pipe insulation
- Energy Star equipment
- Demand limiting or load shifting system

## Remember

- Standard 90.1-2007 is still being finalized and envelope requirements could change
- Standard 189P is under public review and any requirements could change
- Standard 90.1-2010 is still under development and no requirements are final

## Potential Time Line

- ASHRAE Standard 90.1-2010 no later than December 2010
- DOE Determination no later than December 2011
- 2012 IECC in January 2012
- EPA Act Deadline for State Adoption no later than December 2013

## Questions for States

- Are you ready to adopt a new commercial building energy standard that is 30% better?
- Are you ready to enforce a new commercial building energy standard that is 30% better?
- What do you need from DOE to make your answers to the first two questions “yes”?