



ENERGY STAR Multifamily High Rise Meeting the Performance Target Using Addendum bm

Guidance on Calculating Improvement Beyond ASHRAE 90.1-2013 Using Addendum bm

Projects must use the following approach, based upon the equations, tables, and examples¹ of PNNL's [Developing Performance Cost Index Targets for ASHRAE Standard 90.1 Appendix-G – Performance Rating Method](#), to confirm that the 15% performance target is met. Note that for ENERGY STAR MFHR, energy cost savings are permitted for both regulated and unregulated loads (i.e., ENERGY STAR Certified appliances) that are currently permitted in the ENERGY STAR MFHR Simulation Guidelines.

Step 1: Determine Performance Cost Index from the following equation:

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

Note: If modeling savings in unregulated loads, this should be reflected in the Proposed Building Performance only when calculating improvement beyond code to meet the ENERGY STAR performance target. Savings in unregulated loads are not permitted when calculating the PCI for code compliance.

Step 2: Determine the Building Performance Factor:

Based on the Climate Zone where the building is located, identify the Building Performance Factor (BPF) for apartments below. These BPFs may only be used to calculate % improvement above 90.1-2013.

Table 1: Building Performance Factor for Apartments by Climate Zone for ASHRAE 90.1-2013²

CZ	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Apartment	0.78	0.78	0.76	0.74	0.79	0.78	0.73	0.83	0.86	0.86	0.81	0.85	0.86	0.81	0.84	0.79	0.85

Note: The BPF for “Apartment” is applicable to a building with apartments and common space. If the project is a mixed use building, the BPF is the area-weighted average of the appropriate BPF for the building types and Climate Zone from Table 2², on the following page.

Step 3: Determine the Performance Cost Index Target (PCI_t) from the following equation:

$$PCI_t = \frac{(BBUEC + (BPF * BBREC))}{BBP}$$

BPF = Building Performance Factor (Calculated in step 2)

BBP = Baseline building performance

BBREC = Baseline building regulated energy cost

BBUEC = Baseline building unregulated energy cost

Step 4: Determine the percent improvement beyond 90.1-2013 from the following equation:

$$\% \text{ Improvement beyond code} = 100 \times \frac{PCI_t - PCI}{PCI_t}$$

Note: To meet ENERGY STAR, the % improvement must be at least 15%.

¹ While the original Example 2 from the PNNL document is based on ASHRAE 90.1-2010, the example has been modified here to be above ASHRAE Standard 90.1-2013.

² These Building Performance Factors are based upon values in Table 2.3 of the PNNL document.



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Glossary:

PBP = Proposed Building Performance = The annual energy cost for a proposed design, including both regulated and unregulated energy costs, calculated according to Standard 90.1-2013, Appendix G and the ENERGY STAR MFHR Simulation Guidelines.

BBP = Baseline Building Performance = The annual energy cost for a baseline design, including both regulated and unregulated energy costs, calculated according to Standard 90.1-2013, Appendix G.

PCI_t = The maximum Performance Cost Index for a proposed design to comply with Standard 90.1-2013.

BBUEC = Baseline Building Unregulated Energy Cost. The portion of the annual energy cost of a baseline building design that is due to unregulated energy use.

BBREC = Baseline Building Regulated Energy Cost. The portion of the annual energy cost of a baseline building design that is due to regulated energy use.

BPF = Building Performance Factor. Identify “Apartment” BPF based on Climate Zone from Table 2³. The BPF for “Apartment” is applicable to a building with apartments and common space. Where a mixed use building includes apartment and other (non-residential) building area types, the required BPF shall be equal to the area-weighted average of each building area type. For building types not listed in Table 2, use “All Others.”

Table 2: Building Performance Factors (BPF) for Compliance with Standard 90.1-2013

	Climate Zone																	Building Type Average
Building Type	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8	
Office	0.63	0.67	0.62	0.67	0.65	0.69	0.59	0.63	0.65	0.63	0.65	0.66	0.63	0.66	0.66	0.62	0.66	0.65
Retail	0.57	0.63	0.58	0.63	0.59	0.67	0.65	0.60	0.65	0.65	0.60	0.64	0.66	0.60	0.63	0.58	0.58	0.62
School	0.51	0.58	0.52	0.58	0.54	0.57	0.55	0.54	0.55	0.54	0.55	0.55	0.55	0.54	0.55	0.52	0.56	0.55
Healthcare	0.69	0.61	0.65	0.61	0.65	0.61	0.59	0.62	0.58	0.60	0.64	0.57	0.60	0.62	0.57	0.61	0.61	0.61
Restaurant	0.67	0.67	0.63	0.66	0.65	0.65	0.66	0.63	0.60	0.65	0.67	0.63	0.65	0.68	0.65	0.70	0.73	0.66
Hotel	0.69	0.70	0.67	0.65	0.68	0.70	0.69	0.67	0.69	0.67	0.65	0.66	0.65	0.64	0.66	0.62	0.63	0.67
Warehouse	0.56	0.57	0.61	0.63	0.62	0.64	0.68	0.63	0.65	0.68	0.65	0.66	0.70	0.71	0.71	0.72	0.72	0.66
Apartment	0.78	0.78	0.76	0.74	0.79	0.78	0.73	0.83	0.86	0.86	0.81	0.85	0.86	0.81	0.84	0.79	0.85	0.81
All Others	0.67	0.66	0.60	0.62	0.61	0.66	0.64	0.63	0.62	0.66	0.62	0.62	0.66	0.61	0.61	0.58	0.57	0.63

³ These Building Performance Factors are based upon values in Table 2.3 of the PNNL document.



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MFHR Example 1: Using the same building in Example 1 of PNNL's [Developing Performance Cost Index Targets for ASHRAE Standard 90.1 Appendix-G – Performance Rating Method](#).

From the PNNL document:

- Project is a mixed-use building in Chicago, climate zone 5A.
- The building is 50,000 ft² with 10,000 ft² of retail space and 40,000 ft² of residential apartments. Building simulation performed according to the rules of Appendix G-2013 and the Simulation Guidelines result in the following:
 - Proposed building performance = \$24,000/year⁴
 - Baseline building performance (BBP) = \$49,000/year
 - Baseline building regulated energy cost (BBREC) = \$34,000/year
 - Baseline building unregulated energy cost (BBUEC) = \$15,000/year

Question: Does this building demonstrate at least 15% improvement over the Standard 90.1-2013?

Step 1: Determine Performance Cost Index⁵:

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

$$\text{Performance Cost Index} = \frac{\$24,000}{\$49,000} = 0.49$$

Step 2: Determine the Building Performance Factor⁵:

Since the project is a mixed use building, the BPF is the area-weighted average of the appropriate building type BPFs for climate zone 5A from Table 2.

$$\text{Building Performance Factor (BPF)} = \frac{40,000 \text{ ft}^2 * 0.81 + 10,000 \text{ ft}^2 * 0.60}{50,000 \text{ ft}^2} = 0.77$$

Step 3: Determine the Performance Cost Index Target (PCI_t)⁵:

$$PCI_t = \frac{(BBUEC + (BPF * BBREC))}{BBP}$$

$$PCI_t = \frac{(\$15,000 + (0.77 * \$34,000))}{\$49,000} = 0.77$$

Step 4: Determine the percent improvement beyond 90.1-2013⁵:

$$\% \text{ Improvement beyond code} = 100 \times \frac{PCI_t - PCI}{PCI_t}$$

$$\% \text{ Improvement beyond code} = 100 \times \frac{0.77 - 0.49}{0.77} = 36\%$$

Answer: Yes, the % improvement beyond code > 15% (36 > 15)

⁴ This number has been changed from Example 1 of the PNNL document.

⁵ Round to at least two significant figures