

**ANSI/ASHRAE/ICC/USGBC/IES Addendum k to
ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1-2017**

Standard for the Design of High-Performance Green Buildings

Except Low-Rise Residential Buildings

A Compliance Option of the International Green Construction Code®

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FOREWORD

Addendum k adds renewable energy requirements to the performance path of Section 7 to be consistent with requirements being added to the prescriptive path. The addendum includes requirements for treatment of off-site renewable energy sources.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strike through~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum k to Standard 189.1-2017

Modify Section 7.5 as shown. (Note: This addendum makes changes using 189.1-2017 as modified by Addendum ar as the base text.)

7.5 Performance Option

7.5.1 Annual Energy Cost. The proposed building performance cost index (PCI) with consideration of renewables shall be calculated in accordance with ANSI/ASHRAE/IES Standard 90.1, Normative Appendix G, and be equal to or less than the Performance Cost Target, as determined from the following equation:

$$\frac{PCI_{target}}{BBUEC + BBREC} = \frac{BBUEC + (BBREC \times BPF) - REC}{BBUEC + BBREC}$$
$$PCI_{target} = \frac{[BBUEC + (BBREC \times BPF)] \times (1 - RF)}{BBUEC + BBREC}$$

where

PCI_{target} = target PCI required for achieving compliance with the standard, unitless

$BBUEC$ = the component of baseline building performance that is due to unregulated energy use, \$

$BBREC$ = the component of baseline building performance that is due to regulated energy use, or baseline building performance minus $BBUEC$, \$

BPF = building performance factor taken from Table 7.5.2A1, unitless

~~$RECRF$ = renewable energy production fraction from Table 7.5.1, unitless determined from Section 7.4.1.1.1 and converted to cost, \$~~

The proposed building PCI, without consideration of renewables, shall comply with the requirements of ASHRAE/IES Standard 90.1, Section 4.2.1.1.

On-site renewable energy systems in the proposed design shall be calculated using the procedures in Normative Appendix C. For mixed-use buildings, the building performance factor (BPF) shall be determined by weighting each building type by floor area.

7.5.2 Annual Carbon Dioxide Equivalent (CO₂e). The proposed design shall have an annual CO₂e emissions equal to or less than the annual CO₂e emissions of the baseline building design multiplied by the building performance factor (BPF) target determined from Table 7.5.1 using the Performance Rating Method in ASHRAE/IES Standard 90.1, Normative Appendix G. To determine the annual CO₂e for each energy source in the baseline building design and proposed design, the energy consumption shall be multiplied by the CO₂e emission factors from Table 7.5.2.

7.5.3 Zero Energy Performance Index. The zero energy performance index ($zEPI_{2004}$) of the *proposed design*, including *on-site renewable energy systems*, shall be less than the target ($zEPI_{2004 Target}$). $zEPI_{2004}$ and $zEPI_{2004 Target}$ shall be calculated as described below:

Table 7.5.2A1 Energy Cost and CO₂e Building Performance Factors (BPF) and Renewable Fractions (RF)

Building Type	Building Performance Factor (BPF)	Renewable Fraction (RF)
Multifamily	0.71	<u>0.50</u>
Healthcare/hospital	0.56	<u>0.35</u>
Hotel/motel	0.58	<u>0.50</u>
Office	0.54	<u>0.50</u>
Restaurant	0.59	<u>0.10</u>
Retail	0.50	<u>0.50</u>
School	0.37	<u>0.50</u>
Semiheated warehouse	0.44	<u>0.50</u>
All others	0.54	<u>0.50</u>

a. Conditioned warehouses shall use the “All others” category

Table 7.5.2B CO₂e Emission Factors

Building Project Energy Source	CO ₂ e, lb/MWh	CO ₂ e, kg/MWh
Grid-delivered electricity and other fuels not specified in this table	1348	612
LPG or propane	601	273
Fuel oil (residual)	685	311
Fuel oil (distillate)	663	301
Coal	820	372
Gasoline	681	309
Natural gas	509	231
District chilled water	323	146
District steam	855	388
District hot water	807	366

The values in this table represent national averages for the United States and include both direct and indirect emissions.

$$zEPI_{2004} = \frac{\sum_i PDE_i \times r_i}{\sum_i BBSE_i \times r_i}$$

$$EPI_{2004} = \frac{\sum_i PDSE_i \times r_i - \sum_k RE_k \times REPF_k \times r_i}{\sum_i BBSE_i \times r_i}$$

where

$zEPI_{2004}$ = zero energy performance index relative to the Standard 90.1 baseline as defined in the performance rating method of Standard 90.1, Normative Appendix G

$PDSE_i$ = proposed design site energy use for energy type i

$BBSE_i$ = baseline building site energy use for energy type i ; created following the rules in Standard 90.1, Normative Appendix G

r_i = source energy conversion factor for energy type i ; value taken from Table 7.5.3

RE_k = annual renewable energy electricity production for renewable energy procurement method k (see Table 7.4.1.2)

$REPF_k$ = renewable energy factor from Table 7.4.1.2 for renewable energy procurement method k

r_e = source energy conversion factor taken from Table 7.5.3 for electricity

Informative Note: On-site thermal energy and renewable energy contributions to district energy plants are accounted for in the PDE_i term through reductions in electricity and/or gas use. The RE_k term will always be electricity.

$$\frac{zEPI_{2004\ Target} - BBUSE + (BBRSE \times BPF) - RECSE}{BBUSE + BBRSE}$$

$$zEPI_{2004\ Target} = \frac{[BBUSE + (BBRSE \times BPF)] \times (1 - RF)}{BBUSE + BBRSE}$$

where

- $zEPI_{2004\ Target}$ = zero energy performance index target required for achieving compliance with the standard, unitless
- BBUSE = baseline building *unregulated energy use* expressed in source units
- BBRSE = baseline building *regulated energy use* expressed in source units.
- BPF = building performance factor taken from Table 7.5.1, unitless
- ~~RECSE~~ = ~~renewable fraction from Table 7.5.1, unitless energy production determined from Section 7.4.1.1.1 and converted to source energy~~

Revise Table C1.1 as shown.

Table C1.1 Modifications and Additions to ANSI/ASHRAE/IES Standard 90.1, Appendix G, Table G3.1

Proposed Building Performance	Baseline Building Performance
[...]	[...]

15. On-Site Renewable Energy Systems

The reduction in the *proposed building performance annual energy cost, and annual CO₂e emissions and source energy of the proposed design* due to energy generated by *on-site renewable energy systems* shall be calculated as follows:

- a. **Annual Energy Cost.** The annual energy cost of the *proposed design with an on-site renewable energy system* shall be adjusted to account for renewable energy systems calculated on an hourly basis and adjusted as follows.
 - 1. **On-Site Thermal Energy Performance Calculation.** The hourly thermal loads of the *proposed design* shall be reduced by the hourly thermal energy production of the *on-site renewable energy system* (but thermal loads shall not be reduced to less than zero). When the on-site renewable thermal energy production exceeds the applicable thermal demands of the building for any hour, the excess generated energy may be used to displace thermal loads at other times, provided the system has the storage capability and storage losses are included in the calculation. The approved energy rate structure shall be applied to the reduced energy consumption.

Table C1.1 Modifications and Additions to ANSI/ASHRAE/IES Standard 90.1, Appendix G, Table G3.1 (Continued)

Proposed Building Performance	Baseline Building Performance
<p>2. <u>On-Site Electric Renewable Energy—Performance Calculation Systems—Net Metering.</u> The total electrical energy production of the <i>on-site renewable energy system</i> shall be calculated on an hourly basis, and the energy cost of the <i>proposed building performance</i> shall be calculated by applying the approved electrical rate structure to each hour's electrical usage, including any reduction from hourly electrical energy production of the <i>on-site renewable energy system</i>.</p> <p>Exception to (a)(2): For <i>building projects</i> with no net metering agreement, feed-in tariff, or other electrical rate structure for net generated electricity, the cost of imported electricity from the grid is calculated by applying the approved electrical rate structure to each hour's electrical loads minus the hourly electrical energy production of the <i>on-site renewable energy system</i>, but the cost of imported electricity shall not be less than zero on a monthly basis.</p> <p>Electricity production of the <i>on-site renewable energy system</i> that has a retail value in excess of the retail cost of electricity consumption on a monthly basis shall be credited as a reduction in energy costs to the <i>building performance</i> at the wholesale rate as follows:</p> $\text{Credit} = \frac{(\text{ExRR} - \text{ImRR})}{\text{ExRR}} \times \text{ExkWh} \times \text{WR}$ <p>where</p> <p>Credit = cost reduction credit for month where retail value of exported electricity is greater than retail value of imported electricity</p> <p>ExRR = month's value of exported electricity at retail rate</p> <p>ImRR = month's value of imported electricity at retail rate</p> <p>ExkWh = total kilowatt-hours exported in month</p> <p>WR = average monthly wholesale rate for the region where the building located</p> <p><u>Informative Note:</u> Thermal renewable energy is accounted for in (a)(1) above, so the renewable energy addressed in (a)(2) will always be on-site electricity. There is no need to apply the renewable energy procurement factors from Table 7.4.1.2, as the multiplier will always be one (1).</p>	<p>3. <u>Electricity Generation from Off-Site Community Renewable Energy Systems—Virtual-, Aggregated-, or Community-Net Metering Tariff.</u> Renewable energy systems that credit the <i>building project</i> electricity account on an hourly basis shall be calculated according to (a)(2) except that the renewable energy procurement factor from Table 7.4.1.2 shall be applied to each hour of electricity production from the community renewable energy system. The energy cost credit for other off-site renewable energy systems shall be calculated according to (a)(4).</p>

Table C1.1 Modifications and Additions to ANSI/ASHRAE/IES Standard 90.1, Appendix G, Table G3.1 (Continued)

Proposed Building Performance	Baseline Building Performance
<p>4. Electricity Generation from Other Off-Site Renewable Energy Systems. The adjusted renewable energy is the actual renewable energy for each procurement source of renewable energy delivered to or credited to the building project multiplied by the appropriate renewable energy procurement factors in Table 7.4.1.2. The annual energy cost reduction credited to the proposed design shall be the total adjusted renewable energy multiplied by the virtual electric rate paid by the building. The virtual electric rate is the total retail cost for electricity for the year divided by the net consumption for the year in dollars per kWh (\$/kWh).</p> <p>b. Annual CO_{2e}. The annual CO_{2e} emissions of the proposed building that includes an <i>on-site renewable energy system</i> shall be equal to the annual CO_{2e} associated with all of the imported energy to serve the proposed building energy use (with reduced loads due to the <i>on-site renewable energy system</i>) minus the annual <i>adjusted renewable energy</i> exported electricity produced by the <i>on-site renewable energy system</i> multiplied by the electrical CO_{2e} emission factor from Table 7.5.2. Each procurement source of renewable energy delivered to or credited to the building project shall be multiplied by the renewable energy procurement factors in Table 7.4.1.2.</p> $PD-CO_{2e} = \sum PDSE_i \times e_i - \sum RE_k \times RPEF_k \times e_k$ <p>where</p> <p>PD-CO_{2e} ≡ CO_{2e} emissions for the proposed design</p> <p>PDSE_i ≡ proposed design site energy use for energy type <i>i</i></p> <p>e_i ≡ CO_{2e} emission factor for energy type <i>i</i>, taken from Table 7.5.2</p> <p>RE_k ≡ annual renewable energy production for renewable energy type <i>k</i></p> <p>RPEF_k ≡ renewable procurement factor from Table 7.4.1.2 for renewable energy type <i>k</i></p> <p>e_k ≡ CO_{2e} emission factor for electricity taken from Table 7.5.2</p> <p>c. Zero Energy Performance Index. The adjusted renewable energy of the proposed <i>building</i> shall be credited using the source-site multiplier for electricity from Table 7.5.3. On-site thermal energy from solar shall be directly modeled according to Table C1.1, (15)(a)(1) and accounted for through the displacement of on-site fossil fuel or electricity.</p> <p>Documentation: The documentation required in ANSI/ASHRAE/IES Standard 90.1, Section G2.5 (a), (b), and (e), shall be made available to the AHJ, upon request, for all <i>on-site renewable energy systems</i> in the <i>proposed design</i>.</p>	

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ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

Standard 189.1 and the International Green Construction Code

Standard 189.1 serves as the complete technical content of the International Green Construction Code® (IgCC). The IgCC creates a regulatory framework for new and existing buildings, establishing minimum green requirements for buildings and complementing voluntary rating systems. For more information, visit www.iccsafe.org.

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