

Public Review Draft

Proposed Addendum aa to Standard 189.1-2017

Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

Third Public Review Draft (February 2020)
(Draft Shows Proposed Independent Substantive
Changes to Previous Public Review Draft)

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Foreword

This ISC to Addendum aa modifies the definition of carbon dioxide equivalent (CO₂e), deleting GWP values for methane and nitrous oxide which are no longer used. The acronym for GWP is also deleted since it is only used in the definition and is defined there. Informative notes in Section 7.5 are expanded to document key assumptions. References to the eGRID values in Tables 7.5.2 and 7.5.3 are clarified.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum aa to 189.1-2017

Note to Reviewer: Section 7.5 of Standard 189.1 is being modified by multiple addenda. Addenda ar, e, and k are all published on the ASHRAE website. Addendum z is moving through the process of comment response and resolution, but has not yet been published. Changes being made by this addendum shown in ~~strikeout~~/underline are relative to the base document which includes all of those addenda. Since addendum z has not yet been published, that addendum as modified by the second public review ISC is shown at the end of this addendum for informational purposes only. Comments are being accepted only on the changes shown in the first portion of this document.

Modify the definition of CO₂e:

carbon dioxide equivalent (CO₂e): a measure used to compare the impact of various greenhouse gases based on their global warming potential (GWP). CO₂e approximates the time-integrated warming effect of a unit mass of a given greenhouse gas relative to that of carbon dioxide (CO₂). GWP is an index for estimating the relative global warming contribution of atmospheric emissions of ~~1 kg~~ of a particular greenhouse gas compared to emissions of an equal mass 1 kg of CO₂. ~~The following GWP values are used based on a 100-year time horizon: 1 for CO₂, 25 for methane (CH₄), and 298 for nitrous oxide (N₂O).~~

Delete the following acronym:

GWP—global warming potential

Modify Section 7.5.2 as follows:

7.5.2 Annual Carbon Dioxide Equivalent (CO_2e). The *proposed design* shall have annual CO_2e emissions equal to or less than the annual CO_2e emissions of the *baseline building design* multiplied by the performance cost index target determined from 7.5.1. To determine the annual CO_2e for each energy source in the *baseline building design* and *proposed design*, the energy consumption shall be multiplied by the CO_2e emission factors from Table 7.5.3B. U. S. locations shall use values for eGRID subregions from Table 7.5.3B for electricity. values shall be used for electricity where applicable. Locations outside the U. S. shall use the value for “All other electricity” or locally derived values. A building project served in whole or in part by a district energy plant shall follow the modeling requirements contained in Normative Appendix C, Section C1.3, in order to comply with this section.

Modify the description of the term r_e in Section 7.5.3 as follows:

r_e = Source energy conversion factor taken from Table 7.5.3 for electricity. U. S. Locations shall use values for eGRID subregions from Table 7.5.3 for electricity. values shall be used for electricity where applicable. Locations outside the U. S. shall use the value for “All other electricity” or locally derived values.

Modify the Informative Note to Table 7.5.3B to read as follows:

Informative Note: The values in this table represent ~~national~~ averages for the United States and include both direct and indirect emissions. The carbon dioxide equivalent emissions of methane (CH_4) and nitrous oxide (N_2O) are based on their global warming potential for a 20-year time horizon. Other assumptions are documented in Informative Appendix K.

Modify the Informative Note to Table 7.5.3 to read as follows:

Informative Note: Values in this table represent averages for the United States and include both direct and indirect emissions. The source energy conversion factors are based on non-combustible renewable energy having a zero heat rate. Other assumptions are documented in Informative Appendix K.

Modify Section 9.5.1 as follows:

9.5.1 Life-Cycle Assessment (LCA). An *LCA* shall be performed in accordance with ASTM E2921 and ISO Standard 14044, as modified by this section, for a minimum of two building alternatives, both of which shall conform to the *owner’s project requirements (OPR)*. For the purposes of Section 9.5, global warming values used for calculations, results and comparisons shall be based on a 100-year time horizon.

Addendum z to 189.1-2017

Note to reviewers: The first section of this addendum shows changes being made by this addendum relative to Section 7.5 from 189.1-2017 including modifications from Addendum z, i.e., material from z is shown as the base document. The changes open for public review are those in the first section.

This section of the addendum shows Addendum z for informational purposes. These changes are shown with Standard 189.1-2017 plus published addenda ar, e, and k as the base document. The changes shown in this section are not open for public review.

7.5 Performance Option

7.5.1 Annual Energy Cost. The proposed building performance cost index 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 Index (PCI) Target, as determined from the following equation:

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

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 7.5.1, unitless
- RF = renewable energy production fraction from Table 7.5.1, unitless

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

7.5.2 Annual Carbon Dioxide Equivalent (CO_{2e}). The proposed design shall have annual CO_{2e} emissions equal to or less than the annual CO_{2e} emissions of the *baseline building design* multiplied by the performance cost index target determined in accordance with 7.5.1. To determine the annual CO_{2e} for each energy source in the *baseline building design* and *proposed design*, the energy consumption shall be multiplied by the CO_{2e} emission factors from Table 7.5.2B.

Table 7.5.1 Building Performance Factors (BPF) and Renewable Fractions (RF)

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

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

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.

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

where

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

$PDSE_i$ = Proposed design site energy use for energy type i.

$BBSE_i$ = Baseline building site energy use for energy type i. The baseline building is created following the rules in Standard 90.1, Appendix G.

r_i = Source energy conversion factor for energy type i, value taken from Table 7.5.2-1 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. eGRID values shall be used for electricity where applicable.

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.

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

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.

RF = Renewable fraction from Table 7.5.1, unitless.

Informative Note: Informative Appendix I details a methodology for converting $zEPI_{2004}$ to $zEPI$. $zEPI_{2004}$ uses Standard 90.1 Appendix G to define the baseline building. The traditional definition of $zEPI$ uses the median energy of the existing building stock in the year 2000 as the baseline. The traditional $zEPI$ definition is used by the Architecture 2030 program and for other programs.

TABLE 7.5.3 National Average Source Energy Conversion Factors

<u>Energy Type</u>	<u>Conversion Factor (r_i)</u>
<u>Imported Electricity</u>	<u>3.15</u>
<u>Exported Renewable Electricity</u>	<u>3.15</u>
<u>Natural Gas</u>	<u>1.09</u>
<u>Fuel Oil (1,2,4,5,6,Diesel, Kerosene)</u>	<u>1.19</u>
<u>Propane & Liquid Propane</u>	<u>1.15</u>
<u>Steam</u>	<u>1.45</u>
<u>Hot Water</u>	<u>1.35</u>
<u>Chilled Water</u>	<u>1.04</u>
<u>Coal or Other</u>	<u>1.05</u>

Informative Note: The values in this table represent national averages for the United States.

TABLE 7.5.3 Source Energy Conversion Factors

<u>Energy Form</u>	<u>Source Energy Conversion Factor</u>
Fuels Used Directly in Building	
<u>Natural gas</u>	<u>1.09</u>
<u>LPG or propane</u>	<u>1.15</u>
<u>Fuel oil (residual)</u>	<u>1.19</u>
<u>Fuel oil (distillate)</u>	<u>1.19</u>
<u>Coal</u>	<u>1.05</u>
<u>Gasoline</u>	<u>1.19</u>
<u>Other fuels not specified in this table</u>	<u>1.05</u>
Imported Electricity and Exported Renewable Electricity	
<u>AKGD - ASCC Alaska Grid</u>	<u>2.52</u>
<u>AKMS - ASCC Miscellaneous</u>	<u>1.21</u>
<u>AZNM - WECC Southwest</u>	<u>2.75</u>
<u>CAMX - WECC California</u>	<u>1.94</u>
<u>ERCT - ERCOT All</u>	<u>2.58</u>
<u>FRCC - FRCC All</u>	<u>2.97</u>
<u>HIMS - HICC Miscellaneous</u>	<u>2.86</u>
<u>HIOA - HICC Oahu</u>	<u>3.83</u>
<u>MROE - MRO East</u>	<u>3.08</u>
<u>MROW - MRO West</u>	<u>2.50</u>
<u>NEWE - NPCC New England</u>	<u>2.87</u>
<u>NWPP - WECC Northwest</u>	<u>1.39</u>
<u>NYCW - NPCC NYC/Westchester</u>	<u>2.92</u>
<u>NYLI - NPCC Long Island</u>	<u>2.90</u>
<u>NYUP - NPCC Upstate NY</u>	<u>1.97</u>
<u>RFCE - RFC East</u>	<u>3.05</u>
<u>RFCM - RFC Michigan</u>	<u>3.06</u>
<u>RFCW - RFC West</u>	<u>3.14</u>
<u>RMPA - WECC Rockies</u>	<u>2.33</u>
<u>SPNO - SPP North</u>	<u>2.67</u>
<u>SPSO - SPP South</u>	<u>2.46</u>
<u>SRMV - SERC Mississippi Valley</u>	<u>2.95</u>
<u>SRMW - SERC Midwest</u>	<u>3.20</u>
<u>SRSO - SERC South</u>	<u>3.04</u>
<u>SRTV - SERC Tennessee Valley</u>	<u>3.02</u>
<u>SRVC - SERC Virginia/Carolina</u>	<u>3.11</u>
<u>All other electricity</u>	<u>2.64</u>
District Thermal Energy	
<u>Chilled water</u>	<u>0.63</u>
<u>Steam</u>	<u>1.83</u>
<u>Hot water</u>	<u>1.73</u>

Informative Note: Values in this table represent averages for the United States and include both direct and indirect emissions.

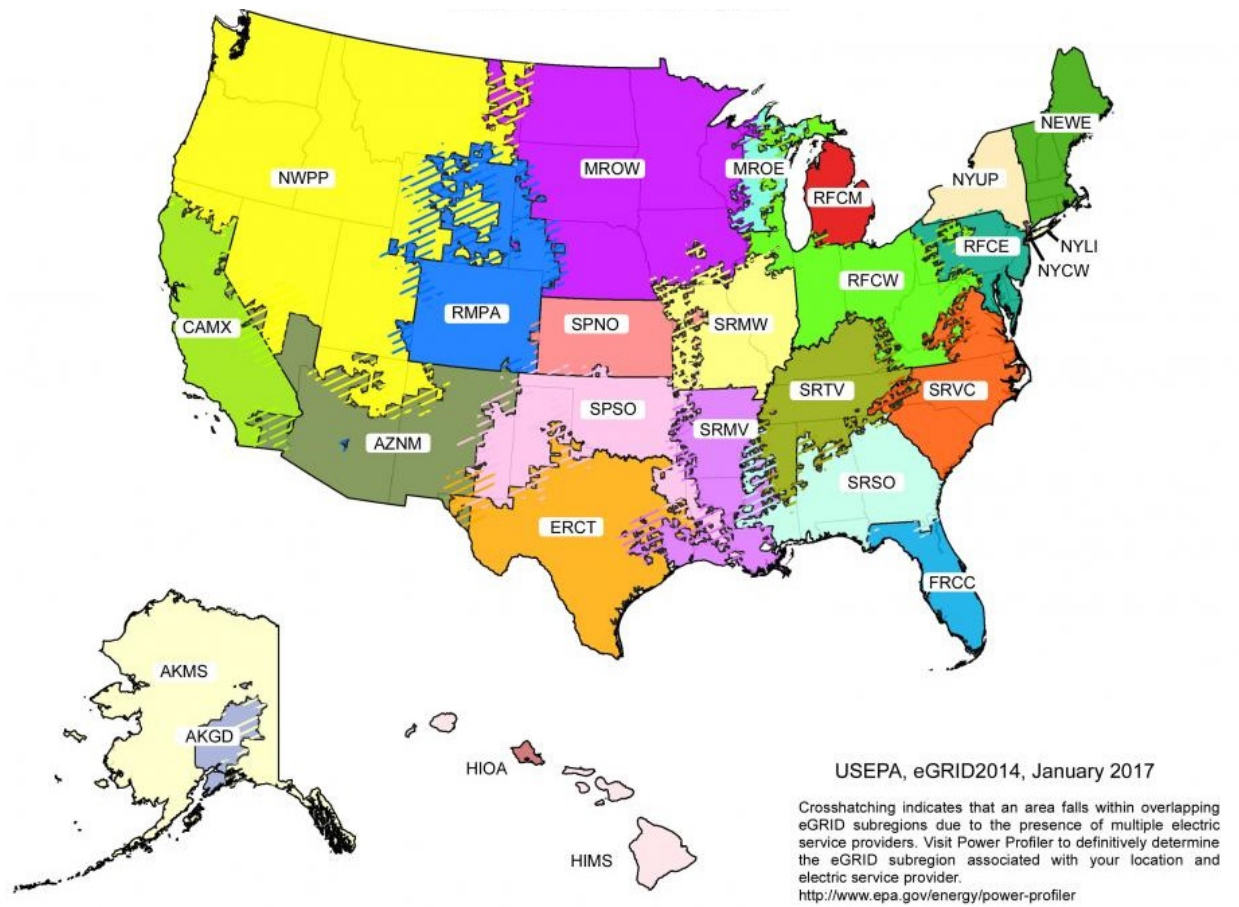


Figure 7.5.3 Map of eGRID Subregions

Crosshatching indicates that an area falls within overlapping eGRID subregions due to the presence of multiple electric service providers. Visit Power Profiler to definitively determine the eGRID subregion associated with your location and electric service provider. See <http://www.epa.gov/energy/power-profiler>.