



**BSR/ASHRAE/IES Addendum I
to ANSI/ASHRAE/IES Standard 90.1-2022**

**Public Review Draft
Proposed Addendum I to
Standard 90.1-2022, Energy
Standard for Sites and Buildings
Except Low-Rise Residential
Buildings**

**Advisory Public Review (May 2023)
(Draft Shows Proposed Changes to Current Standard)**

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FOREWORD

The modification below includes a new informative appendix that modifies Section 3, Section 4, and Appendix G. It is intended to be adopted by jurisdictions or rating authorities wanting to achieve zero emission (ZE) buildings with the energy code over one to three code cycles. The method requires the use of the performance compliance path and includes two performance metric targets. The Performance Energy Index Site (PEI_{site}) provides an efficiency backstop. The Performance Emissions Index Greenhouse Gas (PEI_{CO_2e}) measures zero emissions achievement. The modifications establish the ZE performance requirements for the code cycle. This includes updated BPF values reflected in Table 4.2.1.1 that require additional reductions in regulated energy use calculated from a 12% reduction in total energy use compared to ASHRAE Standard 90.1-2022 values.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~striketrough~~ (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 1 to 90.1-2022

Modify the Informative notes at the end of Section 4.2.1.1 to include the following new item:

...

5. See Informative Appendix M for requirements that can be adopted to achieve buildings with net zero operational energy emissions (ZE), based on greenhouse gas (CO_{2e}) global warming potential, over one or more code cycles, as specified by the jurisdiction or rating authority.

...

Modify the Informative notes at the end of Normative Appendix G Section G1.2.2 to include the following new item:

...

3.

See Informative Appendix M for modifications to Normative Appendix G that that can be adopted to achieve buildings with net zero operational energy emissions (ZE), based on greenhouse gas (CO_{2e}) global warming potential, over one or more code cycles when approved by the rating authority.

...

Add Informative Appendix M as follows (all text is new, but not underlined for ease of reading). Renumber existing Appendix M to Appendix N:

INFORMATIVE APPENDIX M NET ZERO OPERATIONAL ENERGY EMISSIONS PERFORMANCE PATH

M1. GENERAL

This Informative Appendix provides a compliance pathway that may be adopted by a jurisdiction or the rating authority to achieve net zero operational energy emission (ZE) buildings over a defined number of code cycles. The amendments include changes to Section 3, Section 4, and Appendix G. The method requires use of the Appendix G Performance Rating Method and includes two performance metric targets. The Site Performance Energy Index (PEI_{site}) target establishes minimum energy efficiency, and the Greenhouse Gas Performance Emissions Index (PEI_{CO_{2e}}) target establishes the required CO_{2e} emissions reduction.

M2. CHANGES TO SECTION 3

Modify definitions in Section 3.2 as follows:

- a. Replace references to “annual energy cost” with “annual site energy use” in definitions of *baseline building performance* and *proposed building performance*.

Add definitions in Section 3.2 as follows:

- b. **community renewable energy facility:** a facility that produces energy harvested from renewable energy resources and is qualified as a community energy facility under applicable jurisdictional statutes and rules.
- c. **financial renewable energy power purchase agreement:** a financial arrangement between a renewable energy generator and a purchaser wherein the purchaser pays or guarantees a price to the generator for the project’s renewable generation. Also known as a “financial power purchase agreement” and “virtual power purchase agreement.”
- d. **physical renewable energy power purchase agreement:** a contract for the purchase of renewable energy from a specific renewable energy generator to a purchaser of renewable energy.
- e. **renewable energy certificate:** a market-based instrument that represents and conveys the environmental, social, and other non-power attributes of one megawatt hour of renewable electricity generation or 3,412,000 Btu of renewable thermal energy or bioenergy production and could be sold separately from the underlying physical energy associated with renewable energy resources; also known as “energy attribute” and “energy attribute certificate” (EAC).

M3. CHANGES TO SECTION 4

- a. Replace Section 4.2.1.1, in its entirety, with the language in Section M3.1
- b. Add a new section, Section 4.2.1.1.1, using the language in Section M3.2.
- c. Replace Table 4.2.1.1 with Table M3-1
- d. Add a new section, Section 4.2.1.1.2, using the language in Section M3.3, do not include the Informative Note.
- e. Add a new table, Table 4.2.2, based on values in Table M3-2. Electricity greenhouse gas emission factors should only be included in Table 4.2.2 for the eGRID subregion associated with the adopting jurisdiction or *rating authority*.

M3.1 New Buildings (replaces Section 4.2.1.1)

New *buildings* shall comply with Sections 4.2.2 through 4.2.5 and Normative Appendix G. Where using Normative Appendix G, the following performance requirements of new *buildings*, *additions to existing buildings*, and *alterations to existing buildings* shall be met:

- a. The Site Performance Energy Index (PEI_{site}) shall be less than or equal to the Site Performance Energy Index Target ($PEI_{site,t}$) calculated in accordance with Section 4.2.1.1.1.
- b. The Greenhouse Gas Performance Emissions Index (PEI_{CO_2e}) shall be less than or equal to the Greenhouse Gas Performance Emissions Index Target ($PEI_{CO_2e,t}$) calculated in accordance with Section 4.2.1.1.2. The greenhouse gas emissions associated with the building operation energy use shall be calculated using the factors provided in Table 4.2.2. Other values for emissions, including hourly values, for fossil fuels and electricity shall be permitted when adopted by the *rating authority*. Other values for emissions for distributed thermal energy shall be permitted by the *rating authority* and shall account for efficiency of the heating or cooling plant, auxiliary equipment and distribution losses associated with delivery of thermal energy to the building.

Informative Note:

As Section 4.2.1.2 and Section 4.2.1.3 are not amended, it is intended for existing buildings and alterations to have the option to comply either prescriptively in accordance with Sections 5 through 11, using Section 12 “Energy Cost Budget”, or via Appendix G “Performance Rating Method” as modified by this Appendix.

M3.2 Site Performance Energy Index (new section 4.2.1.1.1)

The Site Performance Energy Index Target ($PEI_{site,t}$) is calculated as follows:

$$PEI_{site,t} = \frac{BBUEU_{site} + BPF_{site} * BBREU_{site}}{BBEU_{site}}$$

Where:

- $PEI_{site,t}$ = Site Performance Energy Index Target.
- $BBUEU_{site}$ = *baseline building design* unregulated site energy use, the portion of the annual site energy use of a *baseline building design* that is due to *unregulated energy use*.
- BPF_{site} = *building performance factor* site from Table 4.2.1.1. For *building* area types not listed in Table 4.2.1.1, use “All others.” Where a *building* has multiple *building* area types, the required BPF shall be equal to the area-weighted average of the *building* area types based on their *gross floor area*.
- $BBREU_{site}$ = *baseline building design* regulated site energy use, the portion of the annual site energy use of a *baseline building design* that is due to regulated energy use.
- $BBEU_{site}$ = *baseline building design* site energy use of a *baseline building design* that is due to both regulated energy use and unregulated energy use.

Table M3-1 Building Performance Factor (BPF_{site}) (replaces Table 4.2.1.1)

Buildin g Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Multifamily	0.56	0.51	0.56	0.53	0.55	0.53	0.56	0.53	0.47	0.46	0.51	0.48	0.44	0.47	0.48	0.42	0.44	0.43	0.47
Healthcare/ hospital	0.58	0.56	0.57	0.55	0.54	0.52	0.54	0.54	0.50	0.52	0.53	0.49	0.53	0.52	0.58	0.53	0.56	0.57	0.58
Hotel/motel	0.62	0.61	0.63	0.61	0.62	0.61	0.64	0.64	0.65	0.61	0.64	0.64	0.60	0.62	0.64	0.57	0.60	0.57	0.56
Office	0.42	0.42	0.41	0.41	0.38	0.38	0.36	0.39	0.31	0.34	0.37	0.34	0.36	0.37	0.35	0.37	0.38	0.34	0.37
Restaurant	0.59	0.57	0.57	0.55	0.57	0.53	0.57	0.58	0.59	0.60	0.61	0.61	0.63	0.64	0.63	0.64	0.66	0.65	0.66
Retail	0.41	0.39	0.38	0.38	0.34	0.33	0.33	0.34	0.34	0.38	0.35	0.39	0.42	0.38	0.41	0.43	0.40	0.40	0.42
School	0.44	0.48	0.45	0.48	0.43	0.44	0.45	0.42	0.46	0.35	0.40	0.42	0.38	0.40	0.42	0.37	0.35	0.35	0.38
Warehouse	0.22	0.23	0.19	0.22	0.18	0.20	0.21	0.18	0.15	0.33	0.23	0.26	0.38	0.32	0.27	0.41	0.38	0.37	0.44
All others	0.54	0.52	0.51	0.52	0.44	0.41	0.44	0.43	0.42	0.44	0.43	0.44	0.45	0.44	0.48	0.45	0.46	0.45	0.48

M3.3 Greenhouse Gas Performance Emissions Index (new section 4.2.1.1.2)

The Greenhouse Gas Performance Emissions Index Target (PEI_{CO_{2e,t}}) is specified as follows.

$$PEI_{CO_{2e,t}} = 0$$

Informative Notes:

The target can be set to align with a *rating authority* timeline for achieving zero emissions with energy codes. For example, a target value of zero, achieves zero emissions in the current code cycle. If the *rating authority* plans to achieve zero emissions over two code cycles, the target equals 0.5 in the current code cycle and 0 in the second code cycle. If the goal is to achieve zero emissions over three code cycles, the target equals 0.67 in the current code cycle, 0.5 in the second code cycle and 0 in the third code cycle. Rating authorities may choose to adopt a different timeframe for achieving zero emissions for *alterations*.

Table M3-2 Greenhouse Gas Emissions Factors (new Table 4.2.2)

Greenhouse gas emissions associated with site energy consumption	CO ₂ e Emissions	
	(lb/MWh)	(kg/MWh)
Fossil Fuels Delivered to Buildings		
Natural gas	611	277
LPG or propane	650	295
Fuel oil (residual)	737	334
Fuel oil (distillate)	714	324
Coal	842	382
Gasoline	742	337
Other fuels not specified in this table	842	382
Electricity Delivered to the Building		
eGrid Subregion	(lb/MWh)	(kg/MWh)
AZNM - WECC Southwest	484	220
CAMX - WECC California	181	82
ERCT - ERCOT All	306	139
FRCC - FRCC All	663	301
MROE - MRO East	657	298
MROW - MRO West	436	198
NEWE - NPCC New England	693	314
NWPP - WECC Northwest	379	172
NYCW - NPCC NYC/Westchester	295	134
NYLI - NPCC Long Island	295	134
NYUP - NPCC Upstate NY	295	134
RFCE - RFC East	917	416
RFCM - RFC Michigan	1,141	518
RFCW - RFC West	1,012	459
RMPA - WECC Rockies	543	246
SPNO - SPP North	462	210
SPSO - SPP South	542	246
SRMV - SERC Mississippi Valley	1,020	463
SRMW - SERC Midwest	682	309
SRSO - SERC South	973	441
SRTV - SERC Tennessee Valley	1,123	509
SRVC - SERC Virginia/Carolina	600	272
All other electricity	655	297
Distributed Thermal Energy		
	(lb/MWh)	(kg/MWh)
Chilled Water	0.24*electricity emission factor for the appropriate eGrid subregion	0.24*electricity emission factor for the appropriate eGrid subregion
Steam	1028	466
Hot Water	971	440

Informative Note: The total (combined combustion and pre-combustion) greenhouse gas emissions factors (referred to as CO₂e and associated with CO₂, CH₄, and N₂O) are listed in Table 4.2.2 for fossil fuels and the production of electricity. The delivered fossil fuel factors are U.S. averages based on 2019 EIA and EPA data. The values are consistent with those published in ASHRAE Standard 189.1-2020 Addendum M. The electricity conversion factors are 2022 Cambium long-run marginal emission rates (available at <https://www.nrel.gov/analysis/cambium.html>). The values are site end-use values for the Cambium mid-case scenario, a 20-year levelized analysis (start year of 2023), assuming a 3% discount rate, and a 20-year greenhouse gas global warming period.

M4. CHANGES TO NORMATIVE APPENDIX G

- a. Replace Section G1.2.2, in its entirety, with the language in M4.1
- b. Add a new section, Section G1.2.2.1 Performance Energy Index Site Calculation, using the language in M4.2
- c. Add a new table, Table G1.2.2.2-1, using the values in Table M4-1.
- d. Add a new section, Section G1.2.2.2 Performance Emissions Index Greenhouse Gas Calculation, using the language in M4.3
- e. Add a new section, G1.2.2.3. Off-Site Renewable Energy Procurement, using the language in M4.4.
- f. Add a new section, G1.2.2.3.1 Off-Site procurement paths, using the language in M4.4.1
- g. Add a new section, G1.2.2.3.2 Off-Site contract terms, using the language in M4.4.2
- h. Add a new section, G1.2.2.3.3 Renewable energy certification documentation, using the language in M4.4.3.
- i. Replace Section G1.3.2 item n, in its entirety, with “Greenhouse gas emission conversion factors used to calculate the *proposed design* greenhouse gas emissions.”
- j. Append Section G1.3.2 item q to include, “production and off-site renewable energy procurement”, after the term *on-site renewable energy*.

M4.1 Performance Rating Calculation (replaces Section G1.2.2)

The performance of the *proposed design* is calculated in accordance with provisions of this appendix using the formulas provided in Section G1.2.2.1 and Section G1.2.2.2.

Both the *proposed building performance* and the *baseline building performance* shall include all end-use load components within and associated with the building when calculating the Performance Site Energy Index and the Performance Emissions Index Greenhouse Gas.

Exception to G1.2.2:

Energy used to recharge or refuel vehicles that are used for off-site transportation purposes shall not be modeled in the *baseline building performance* or the *proposed building performance*.

M4.2 Performance Site Energy Index Calculation (new Section G.1.2.2.1)

$$PEI_{site} = \frac{PBGEU_{site}}{BBEU_{site}}$$

Where:

- PEI_{site} = Site Performance Energy Index.
- $PBGEU_{site}$ = Proposed building gross site energy use, the regulated and unregulated site energy use of the *proposed design*, calculated in accordance with Appendix G, excluding the contribution of on-site renewable energy production and off-site renewable energy procurement.
- $BBEU_{site}$ = *baseline building design* site energy use is the regulated and unregulated energy use of the *baseline building design* calculated in accordance with Section G1.2

M4.3 Performance Emissions Index Greenhouse Gas Calculation (new Section G.1.2.2.2)

If $PBGEU_{CO2e} > 0$

$$PEI_{CO2e} = \frac{PBNEU_{CO2e}}{PBGEU_{CO2e}}$$

If $PBGEU_{CO2e} = 0$

$$PEI_{CO2e} = 0$$

Where:

- PEI_{CO2e} = Greenhouse Gas Performance Emissions Index
- PBNEU_{CO2e} = the *proposed design* emissions associated with the proposed building net site energy including the emission reductions associated with on-site renewable energy production and off-site renewable energy procurement, based on the greenhouse gas emissions conversion factors provided in Table 4.2.2.
- PBGEU_{CO2e} = the *proposed design* gross greenhouse gas emissions associated with the proposed building site energy use, excluding the emission reductions associated with on-site renewable energy production and off-site renewable energy procurement, based on the greenhouse gas emissions conversion factors provided in Table 4.2.2.

And

$$PBNEU_{CO2e} = PBGEU_{CO2e} - AE$$

$$AE = \sum_{i=1}^n RE_i * REPF_i * GHG_i$$

Where:

- AE = the avoided emissions from onsite renewable energy production and off-site renewable energy procured in accordance with Section G1.2.2.3.
- RE_i = annual energy generation for the ith renewable energy procurement method or class.
- REPF_i = renewable energy procurement factor for the ith renewable energy procurement method or class from Table G1.2.2.2-1.
- GHG_i = greenhouse gas emission conversion factor from Table 4.2.2. Select the factor value that corresponds to the energy source that the ith renewable energy system is displacing.

Table M4-1 Renewable Energy Procurement Factors (new Table G1.2.2.2-1)

Class	Procurement Factor	Classification
1	1.0	On-site production Off-site procurement - <i>Community Renewable Energy Facility</i>
2	1.0	Off-site procurement – In buildings that: 1. Include <i>equipment</i> for <i>on-site renewable energy</i> with a rated capacity of not less than 0.75 W/ft ² or 2.6 Btu/ft ² multiplied by the sum of the <i>gross conditioned floor area</i> for all floors up to the three largest floors, or 2. Meets exception 1, 2, or 3 to 10.5.1.1
3	0.5	Off-site procurement - Other

M4.4 Off-site Renewable Energy (new Section G1.2.2.3)

M4.4.1 Off-site procurement paths (new Section G1.2.2.3.1)

The building owner shall procure and be credited for the total amount of off-site renewable energy using one or more of the following:

1. *A physical renewable energy power purchase agreement.*
2. *A financial renewable energy power purchase agreement.*
3. *A community renewable energy facility.*
4. Off-site renewable energy system owned by the building property owner.

The renewable energy source shall be located where the energy can be delivered to the building *site* by any of the following:

1. Direct connection to the off-site renewable energy facility
2. The local utility or distribution entity
3. An interconnected electrical or pipeline network where energy delivery capacity between the generator and the building *site* is available

M4.4.2 Off site contract terms. (new Section G1.2.2.3.2)

The total off-site renewable energy shall be delivered or credited to the *building site* under an energy contract with a duration of not less than 10 years. The contract shall be structured to survive a partial or full transfer of ownership of the building property.

M4.4.3 Renewable energy certificate documentation (new Section G1.2.2.3.3)

The property owner or owner's authorized agent shall demonstrate that for an on-site or off-site renewable energy system required to comply this appendix, no RECs or EACS are associated with the renewable energy system or the following provisions for RECS and EACS shall be met:

1. The RECS and EACS are retained and retired by or on behalf of the property owner or tenant for a period of not less than 15 years;
2. The RECS and EACS are created within a 12-month period of the use of the REC; and
3. The RECS and EACS are from an asset placed in service no more than 5 years before the issuance of the certificate of occupancy.