_____Public Review Draft

Proposed Addendum bi to Standard 90.1-2022, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

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FOREWORD

The modification changes the metric from energy cost to site energy use when determining compliance with the Appendix G Performance Rating Method. Use of site energy as the metric better supports ASHRAE and SSPC goals of net zero operational energy emission buildings.

This addendum to the standard is designed to provide increased flexibility and therefore was not subjected to cost effectiveness analysis.

[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 bi to 90.1-2022

Revise Section 3.1 as follows:

baseline building performance: the annual ~~energy cost~~ site energy use for a *building* design intended for use as a baseline for rating above-standard design or when using the *Performance Rating Method* as an alternative path for minimum standard compliance in accordance with Section 4.2.1.1.

proposed building performance: the annual ~~energy cost~~ site energy use calculated for a *proposed design*.

Revise Section 4 as follows:

4.2 Compliance

4.2.1 Compliance Paths

4.2.1.1 New Buildings. New *buildings* shall comply with Section 4.2.2 through 4.2.5 and either the pro- visions of

    a. Sections 5, "Building Envelope"; 6, "Heating, Ventilating, and Air Conditioning"; 7, "Service Water Heating"; 8, "Power"; 9, "Lighting"; 10, "Other Equipment"; and 11, "Additional Efficiency Requirements," or

    b. Section 12, "Energy Cost Budget Method," or

    c. Normative Appendix G, "Performance Rating Method."

      When using Normative Appendix G, ~~the Performance Cost Index (PCI) of~~ for new *buildings*, *additions* to *existing buildings*, and/or *alterations* to *buildings*, the following

requirements shall be met less than or equal to the Performance Cost Index Target (PCI~t~) when calculated in accordance with the following:

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 this Section. Site energy shall be determined using the site energy conversion factors provided in Table 4.2.1-2. Conversion factors for energy sources not included in Table 4.2.1-2 shall be approved by the rating authority.

The Site Performance Energy Index Target (PEI~*site,t*~) is calculated as follows:

$$P\underline{E}I_{site,t} = [BBUE\underline{U} + (BPF \times BBRE\underline{U}) - PRE] / BBP$$

where

P~C~EI~site,t~	=	Site Performance ~Cost~ Energy Index ~Target~ ~calculated in accordance with Section G1.2.2~
BBUE~C~U	=	*baseline building design* unregulated *site energy* ~cost~ use, the portion of the annual *site energy* ~cost~ use of a *baseline building design* that is due to *unregulated energy use*
BPF	=	*building* performance factor 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*. Where a project includes an *existing building* and an *addition*, the required BPF shall be equal to the area-weighted average, based on the *gross floor area*, of the *existing building* BPF determined as described in Section 4.2.1.3 and the *addition* BPF from Table 4.2.1.1.
BBRE~C~U	=	baseline *building design* regulated *site energy* ~cost~ use, the portion of the annual *site energy* ~cost~ use of a *baseline building design* that is due to *regulated energy use*
PRE	=	$PBP_{nre} - PBP_{pre}$
PBP	=	*proposed building performance*, including the reduced, annual *purchased energy* ~cost~ use associated with all *on-site renewable energy* generation *systems*
PBP~*nre*~	=	*proposed building performance* without any credit for reduced annual *energy* ~costs~ use from *on-site renewable energy* generation *systems*
PBP~*pre*~	=	*proposed building performance*, excluding any renewable *energy system* in the *proposed design* and including an *on-site renewable energy system* that meets but does not exceed the requirements of Section 10.5.1.1 modeled following the requirements for a *budget building design* in Table 12.5.1, row 15
BBP	=	*baseline building performance*

~Regulated~ *~energy~* ~cost shall be calculated by multiplying the total~ *~energy~* ~cost by the ratio of~ *~regulated energy use~* ~to total~ *~energy~* ~use for each~ *~fuel~* ~type. Unregulated~ *~energy~* ~cost shall be calculated by subtracting regulated~ *~energy~* ~cost from total~ *~energy~* ~cost.~

When $(PBP_{pre} - PBP)/BBP > 0.05$, new *buildings*, *additions* to *existing buildings*, and/or *alterations* to *existing buildings* shall comply with the following:

$$P\underline{E}I_{site} + [(PBP_{pre} - PBP)/BBP] - 0.05 < P\underline{E}I_{site,t}$$

Informative Notes:

1. PBP_{nre} = *proposed building performance*, no renewable *energy*.
2. PBP_{pre} = *proposed building performance*, prescriptive renewable *energy*.
3. PRE = prescriptive renewable *energy*.
4. See Informative Appendix I for using other metrics, including ~~site energy,~~ source *energy,* and carbon emissions, in conjunction with the Normative Appendix G *Performance Rating Method* when approved by the *rating authority*.

Table 4.2.1.1 Building Performance Factor (BPF)

~~Building Area Type~~	~~Climate Zone~~																		
	~~0A~~	~~0B~~	~~1A~~	~~1B~~	~~2A~~	~~2B~~	~~3A~~	~~3B~~	~~3C~~	~~4A~~	~~4B~~	~~4C~~	~~5A~~	~~5B~~	~~5C~~	~~6A~~	~~6B~~	~~7~~	~~8~~
~~Multifamily~~	~~0.69~~	~~0.68~~	~~0.71~~	~~0.70~~	~~0.72~~	~~0.72~~	~~0.71~~	~~0.76~~	~~0.63~~	~~0.69~~	~~0.76~~	~~0.71~~	~~0.66~~	~~0.72~~	~~0.71~~	~~0.65~~	~~0.67~~	~~0.65~~	~~0.67~~
~~Healthcare/hospital~~	~~0.69~~	~~0.69~~	~~0.70~~	~~0.68~~	~~0.67~~	~~0.65~~	~~0.65~~	~~0.66~~	~~0.64~~	~~0.64~~	~~0.66~~	~~0.63~~	~~0.67~~	~~0.65~~	~~0.65~~	~~0.66~~	~~0.67~~	~~0.68~~	~~0.70~~
~~Hotel/motel~~	~~0.66~~	~~0.66~~	~~0.69~~	~~0.65~~	~~0.65~~	~~0.64~~	~~0.64~~	~~0.65~~	~~0.65~~	~~0.63~~	~~0.65~~	~~0.63~~	~~0.62~~	~~0.63~~	~~0.62~~	~~0.61~~	~~0.62~~	~~0.59~~	~~0.58~~
~~Office~~	~~0.54~~	~~0.54~~	~~0.53~~	~~0.52~~	~~0.52~~	~~0.52~~	~~0.50~~	~~0.54~~	~~0.48~~	~~0.48~~	~~0.53~~	~~0.48~~	~~0.49~~	~~0.52~~	~~0.48~~	~~0.48~~	~~0.49~~	~~0.46~~	~~0.48~~
~~Restaurant~~	~~0.62~~	~~0.59~~	~~0.57~~	~~0.57~~	~~0.57~~	~~0.53~~	~~0.57~~	~~0.53~~	~~0.51~~	~~0.55~~	~~0.54~~	~~0.54~~	~~0.57~~	~~0.56~~	~~0.55~~	~~0.59~~	~~0.58~~	~~0.61~~	~~0.64~~
~~Retail~~	~~0.51~~	~~0.49~~	~~0.48~~	~~0.48~~	~~0.44~~	~~0.43~~	~~0.43~~	~~0.43~~	~~0.44~~	~~0.42~~	~~0.43~~	~~0.46~~	~~0.43~~	~~0.42~~	~~0.47~~	~~0.43~~	~~0.43~~	~~0.41~~	~~0.44~~
~~School~~	~~0.52~~	~~0.57~~	~~0.57~~	~~0.56~~	~~0.52~~	~~0.53~~	~~0.52~~	~~0.49~~	~~0.50~~	~~0.46~~	~~0.47~~	~~0.47~~	~~0.47~~	~~0.46~~	~~0.46~~	~~0.46~~	~~0.44~~	~~0.45~~	~~0.45~~
~~Warehouse~~	~~0.26~~	~~0.26~~	~~0.22~~	~~0.25~~	~~0.21~~	~~0.22~~	~~0.25~~	~~0.21~~	~~0.19~~	~~0.25~~	~~0.22~~	~~0.22~~	~~0.28~~	~~0.24~~	~~0.22~~	~~0.31~~	~~0.28~~	~~0.29~~	~~0.32~~
~~All others~~	~~0.62~~	~~0.60~~	~~0.62~~	~~0.59~~	~~0.55~~	~~0.51~~	~~0.53~~	~~0.52~~	~~0.55~~	~~0.53~~	~~0.52~~	~~0.55~~	~~0.53~~	~~0.53~~	~~0.56~~	~~0.54~~	~~0.54~~	~~0.54~~	~~0.54~~

Building Area Type	Climate Zone																		
	0A	**0B**	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**4B**	**4C**	**5A**	**5B**	**5C**	**6A**	**6B**	**7**	**8**
Multifamily	0.72	0.71	0.75	0.73	0.76	0.76	0.77	0.75	0.70	0.61	0.71	0.64	0.56	0.63	0.63	0.54	0.57	0.54	0.56
Healthcare/hospital	0.67	0.66	0.68	0.65	0.65	0.61	0.62	0.64	0.63	0.62	0.63	0.61	0.65	0.63	0.68	0.64	0.68	0.69	0.71
Hotel/motel	0.69	0.69	0.72	0.68	0.69	0.68	0.69	0.70	0.71	0.65	0.69	0.68	0.63	0.66	0.67	0.60	0.64	0.59	0.58
Office	0.54	0.54	0.53	0.52	0.52	0.52	0.50	0.54	0.47	0.47	0.52	0.48	0.49	0.52	0.49	0.48	0.50	0.43	0.46
Restaurant	0.64	0.61	0.60	0.59	0.60	0.57	0.61	0.62	0.61	0.66	0.65	0.66	0.69	0.69	0.68	0.71	0.71	0.72	0.74
Retail	0.51	0.49	0.48	0.48	0.44	0.43	0.43	0.44	0.44	0.47	0.45	0.50	0.52	0.47	0.52	0.52	0.50	0.48	0.49
School	0.52	0.57	0.57	0.56	0.52	0.53	0.53	0.52	0.55	0.42	0.49	0.53	0.44	0.50	0.51	0.43	0.42	0.42	0.44
Warehouse	0.26	0.26	0.22	0.25	0.21	0.22	0.25	0.21	0.18	0.38	0.27	0.31	0.46	0.37	0.31	0.49	0.42	0.43	0.47
All others	0.63	0.62	0.65	0.61	0.56	0.53	0.55	0.55	0.59	0.55	0.55	0.58	0.57	0.57	0.61	0.57	0.57	0.56	0.58

Table 4.2.1-2 Site Energy Conversion Factors

Building **Project** *Energy* **Source**	**Units**	**Site** *energy* **Btu/unit**
Electricity	kWh	3,412
Natural Gas	Therm	100,000
Propane	Therm	100,000
Distillate fuel oil	Gallon	137,600
District Chilled Water	Ton	12,000
District Steam*	Pound	1,150
District Hot Water	Therm	100,000

*Saturated steam at 1 atmosphere (14.696 psia)

For the Appendix G revisions that follow, note that revisions to Section G2.4.2 were previously proposed in Addendum ar, which has not yet been published. The changes proposed here are intended to supersede the current standard as well the language previously introduced in Addendum ar.

Normative Appendix G
Performance Rating Method

G1.2.2 Performance Rating Calculation. The performance of the *proposed design* is calculated in accordance with provisions of this appendix using the following formula:

Site Performance ~~Cost~~ Energy Index = *Proposed building performance*/*Baseline building performance*

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

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*.

Informative Notes:
1. Neither the *proposed building performance* nor the *baseline building performance* are predictions of actual *energy* consumption ~~or costs~~ for the *proposed design* after *construction*. Actual experience will differ from these calculations due to variations such as occupancy, *building* operation and maintenance, weather, *energy* use not covered by this procedure, ~~changes in *energy* rates between design of the *building* and occupancy,~~ and the precision of the calculation tool.
2. See Informative Appendix I for using other metrics, including ~~site *energy*,~~ source *energy*, and carbon emissions, in conjunction with the Normative Appendix G *Performance Rating Method* when approved by the *rating authority*.

…

G1.3.2 Application Documentation. The following documentation shall be submitted to the *rating authority:*

a. The *simulation program* used, the version of the *simulation program*, and the results of the *energy* analysis, including the calculated values for baseline *building* unregulated *energy* ~~cost~~ use (BBUE~~C~~U), baseline *building* regulated *energy* ~~cost~~ use (BBRE~~C~~U), *building* performance factor (BPF), *baseline building performance*, the *proposed building performance*, Site Performance ~~Cost~~ Energy Index (P~~C~~EI$_{site}$), and Site Performance ~~Cost~~ Energy Index Target (P~~C~~EI$_{site,t}$).

…
~~n. *Purchased energy rates* used in the simulations.~~
~~o.~~ n. An explanation of any error messages noted in the *simulation program* output.
…

G2.4 Renewable, and Recovered, and Purchased Energy.

G2.4.1 On-Site Renewable Energy and Site-Recovered Energy. *Site-recovered energy* ~~shall not be considered purchased energy and~~ shall be subtracted from the *proposed design energy* consumption prior to calculating the *proposed building performance*. *On-site renewable energy* shall be subtracted from the *proposed design energy* consumption prior to calculating the *proposed building performance*, provided that the *building owner*
a. owns the *on-site renewable energy system* or
b. has signed a lease agreement for the *on-site renewable energy system* for at least 15 years or
c. has signed a contractual agreement to purchase *energy* generated by the *on-site renewable energy system*

for at least 15 years.

G2.4.2 ~~**Annual Energy Costs.**~~ **On-Site Electricity Generation Systems.** ~~The *design energy cost* and baseline *energy* cost shall be determined using either actual rates for *purchased energy* or state average *energy* prices published by U.S. DOE's Energy Information Administration (EIA) for commercial *building* customers, but rates from different sources may not be mixed in the same project. Where *on-site renewable energy* or *site-recovered energy* is used, the *baseline building design* shall be based on the *energy* source used as the backup *energy* source, or the baseline *system energy* source in that category if no backup *energy* source has been specified, except where the baseline *energy* source is prescribed in Tables G3.1.1-2 and G3.1.1-3.~~ Where the *proposed design* includes *onsite electricity generation systems* other than *on-site renewable energy systems*, the baseline design shall include the same generation *systems* excluding its *site-recovered energy*.

~~***Informative Note:*** The above provision allows users to gain credit for features that yield load management benefits. Where such features are not present, users can simply use state average unit prices from EIA, which are updated annually and readily available on EIA's website (www.eia.gov).~~

G2.5 Exceptional Calculation Methods. When the *simulation program* does not model design, material, or device of the *proposed design*, an exceptional calculation method shall be used as approved by the *rating authority*. Where there are multiple designs, materials, or devices that the *simulation program* does not model, each shall be calculated separately and exceptional savings determined for each. At no time shall the total exceptional savings constitute more than half of the difference between the *baseline building performance* and the *proposed building performance*. All applications for approval of an exceptional method shall include the following:

a. Theoretical and empirical information verifying the method's accuracy, and step-by-step documentation of the exceptional calculation method performed, detailed enough to reproduce the results.
b. Copies of all spreadsheets used to perform the calculations.
c. A sensitivity analysis of *energy* consumption when each of the input parameters that are estimated is varied
d. from half to double the value assumed.
e. The calculations shall be performed on a time-step basis consistent with the *simulation program* used.
f. The Site Performance ~~Cost~~ Index calculated with and without the exceptional calculation method.