ADDENDA

ANSI/ASHRAE/IES Addendum j to
ANSI/ASHRAE/IES Standard 90.2-2018

Energy Efficient Design of Low-Rise Residential Buildings

Approved by the ASHRAE Standards Committee on June 22, 2024, by the Illuminating Engineering Society on May 8, 2024, and by the American National Standards Institute on July 23, 2024.

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FOREWORD

Addendum j makes three modifications to the current standard. First, it allows for the use of offsite power owned by the building owner to be counted toward the Energy Rating Index (ERI) score. Second, it includes requirements for energy storage when on-site or off-site power is being used to meet the ERI score. Third, it lowers the ERI and CO_2e Rating Index (CRI) requirements when using on-site or off-site power while establishing an efficiency backstop. This new language expands access to renewable power systems when on-site power is not possible. It also ensures that the building incorporating the renewable power is best able to capture the benefits from it.

ERI scores were based on an analysis conducted by Pacific Northwest National Laboratory (PNNL) where 4 kW of solar photovoltaic was installed on reference housing in each climate zones. CRI scores were lowered by ten points where renewable power systems are utilized based on the additional carbon free energy and the required energy storage provisions. Both ERI and CRI were separately validated for accuracy and determined to be achievable in each climate zone. Energy storage factors were taken from a 2021 analysis by the U.S. Energy Information Administration (EIA) that found that utility-scale batteries and pumped storage generally return about 80% of the electricity they store. A distance loss factor of 0.0008 was taken from a 2015 Oak Ridge National Laboratory study (ORNL/TM-2015/5) that found a 345 kV utility line loses 160 MW per 100 miles for 2000 MW transmitted.

This addendum is motivated by the desire of both ASHRAE as an institution and SSPC 90.2 and numerous other stakeholders to approach net zero energy and carbon within the five-year publication schedule for ASHRAE Standard 90.2. An approach to net zero clearly depends on incorporating more renewable energy into the requirements, and this goal may not be practical with on-site generation alone in many cases. Two examples are where the site is constrained by offsite shading or is small in comparison to the floor area of the building, such as for a 40-story condominium building in a large downtown.

The provisions in this addendum are needed to support a move to encourage renewables more strongly in the standard. The 2018 edition assumed some modest amount of renewable energy in developing the ERI requirements, but the targets are feasible to achieve with efficiency alone and are required to do so in this addendum. But the lower ERI and CRI requirements all but require some renewables, and evidently the net zero goals cannot be met by efficiency alone.

We noted in developing this addendum that the goal of an adoptable net zero standard requires these considerations. On the other hand, we observe, and seek comment on the observation, that a net zero appendix can be extremely simple when the rules in this addendum are added to the normative portion of the standard: the net zero requirements are simply to meet the rest of the standard and achieve ERI or CRI ratings of zero.

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

Addendum j to Standard 90.2-2018

Modify Section 3 as shown.

community renewable energy facility: a facility that produces energy from a renewable energy system and is qualified as a community renewable energy facility under applicable regulations.

off-site power production: energy that is legally bound to a dwelling-unit owner that is generated by one of the following entities:

a. A *community renewable energy facility*
b. A *renewable energy investment fund*
c. An off-site *renewable energy system* owned by the dwelling-unit owner
d. A financial renewable power purchase agreement
e. A physical renewable power purchase agreement
f. A utility green-power purchase program

on-site power production: energy generated from a *renewable energy system* ~~sources~~ produced at the building site.

renewable energy certificate (REC)**:** a market-based instrument that represents and conveys the environmental, social, and other nonpower attributes of one megawatt hour of renewable electricity generation and could be sold separately from the underlying physical electricity associated with *renewable energy systems.*

renewable energy investment fund: an entity that installs renewable energy capacity on behalf of the owner.

renewable energy power purchase agreement (PPA), financial: a financial arrangement between a renewable electricity 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."

renewable energy power purchase agreement (PPA), physical: a contract for the purchase of renewable electricity from a specific renewable electricity generator to a purchaser of renewable electricity.

~~***on-site***~~ ***renewable energy system:*** photovoltaic, ~~solar thermal,~~ geothermal energy (not including ground-source heat pumps), and wind systems ~~located on the *building site* and~~ used to generate energy.

[. . .]

Modify Section 5.2.1 as shown.

5.2.1 Envelope Assemblies. All new envelope assemblies comprising the *alteration* shall meet or exceed the envelope *assembly* characteristics of Table 6-~~2~~3 and Table 7-2.

[. . .]

Modify Section 6 as shown.

6. PERFORMANCE REQUIREMENTS

6.1 The *dwelling unit* shall be planned, designed, and constructed to achieve the *Energy Rating Index* (*ERI*) and CO_2e Rating Index (CRI) by climate zone shown in Table 6-1 ~~and a CO_2e Index of 55 or less~~.

6.1.1 The *ERI* of the proposed design shall be determined using the energy simulation program conducted in accordance with ANSI/RESNET/ICC Standard 301-2022, as modified by the modeling requirements included in Normative Appendices A and B.

6.1.2 The CRI~~CO_2e Index~~ of the proposed design shall be determined using the energy simulation program conducted in accordance with the provisions of ANSI/RESNET/ICC Standard 301-2022, including Addendum B-2022.

6.2 ~~On Site~~ Renewable Power Utilization. When *on-site power production* or *off-site power production* is used to meet the *ERI* requirements of Section 6.1, the following requirements ~~for building thermal envelope and envelope air leakage~~ shall be met.

6.2.1 Building Thermal Envelope. Where present, the building envelope components shall have solar heat gain coefficient (SHGC) values and U-factors no greater than the values shown in Table 6-~~2~~3.

6.2.2 Maximum Envelope Air Leakage. The building or dwelling unit shall have a tested air leakage rate no greater than 5 ACH50 in Climate Zones 0 through 2 and no greater than 3 ACH50 in Climate Zones 3 through 8.

6.2.3 Limits on ERI and CRI. The *ERI* and CRI shall be calculated counting only the efficiency features, and not the *renewable energy systems*, and achieve a rating by climate zone shown in Table 6-2. The *ERI* and CRI shall achieve a rating by climate zone shown in Table 6-1 when including *renewable energy systems*. Requirements of both Tables 6-1 and 6-2 shall be met when using *renewable energy systems* to comply with this standard.

6.2.4 Energy Storage. A permanently installed energy storage device(s) with a capacity of 7.5 kWhs or greater shall be installed on the building site or at the off-site power production site. All ancillary components needed to transform the stored energy to energy that can be used by the building must also be installed.

Informative Note: It is permissible to utilize off-site power production and have the energy storage device installed at the building site.

6.3 Off-Site Power Utilization When *off-site power production* is used, *ERI* shall be calculated in accordance with BSR/RESNET/ICC 301 with the OPP in Equation 4.1.2 of BSR/RESNET/ICC 301 replaced with OPP_{adj} as calculated in accordance with Equation 6-1. O*ff-site power production* shall meet the requirements of Section 6.3.1. *RECs* generated in conjunction with off-site power shall be retired on behalf of the dwelling-unit owner.

$$OPP_{adj} = OPP + \sum_i^n RE_i \times PF_i \qquad (6\text{-}1)$$

Table 6-1 Maximum Energy Rating Index for Compliance with This Standard

Climate Zone	Energy Rating Index (ERI)	CO_2e Rating Index (CRI)
0	~~43~~20	45
1	~~43~~20	45
2	~~45~~20	45
3	~~47~~20	45
4	~~47~~25	45
5	~~47~~32	45
6	~~46~~35	45
7	~~46~~40	45
8	~~45~~40	NA

Table 6-2 Maximum Energy Rating Index without Including Renewable Energy Systems for Compliance with This Standard

Climate Zone	Energy Rating Index (ERI) without including Renewable Energy Systems	CO_2e Rating Index (CRI) without including Renewable Energy Systems
0	43	55
1	43	55
2	45	55
3	47	55
4	47	55
5	47	55
6	46	55
7	46	55
8	46	NA

Table 6-3 Procurement Factor Coefficients

Term	Value
η_{stor}	0.8
η_{trans}	.95
d_{loss}	0.0008 kW/mile

OPP_{adj} = on-site and off-site power

OPP = electric power produced on the site of a rated home as defined in RESNET/ICC 301

RE_i = annual energy procured with the i^{th} procurement method

PF_i = procurement factor for i^{th} procurement method as determined in Equation 6-2

$$PF_i = \eta_{stor} \times \eta_{trans} \times [1 - (d_{dist} \times d_{loss})] \quad (6\text{-}2)$$

where

η_{stor} = round-trip efficiency of off-site energy storage

η_{trans} = efficiency of all transformers between where the electricity is produced and site being evaluated

d_{dist} = distance between where the electricity is produced and site being evaluated, measured in the most direct way possible, miles

d_{loss} = energy lost per distance, kW/mile

Table 6-~~2~~3 Maximum SHGC and U-factors When ~~On-Site Power~~ Renewable Energy Systems are ~~On-Site Power Is~~ Used (I-P Units)

Table 6-~~2~~3 Maximum SHGC and U-factors When ~~On-Site Power~~ Renewable Energy Systems are ~~On-Site Power Is~~ Used (SI Units)

Modify Table 7-2 and Section 7.6.3.5 and as shown.

Table 7-2 Minimum R-Value and Insulation Depth for Slab Constructions when Renewable Energy Systems are ~~On-Site Power Is~~ Used

[. . .]

7.6.3.5 Covers. Heated *pools* and in-ground, permanently installed *spas* shall be provided with a vapor-retardant cover.

Exception to 7.6.3.5: Where more than 75% of the energy for heating, computed over an operating season of at least 3 months, is from a ~~an *on-site* renewable energy system~~.

Modify Section 8.7 as shown.

8.7 ~~On-Site Power~~ Renewable Energy Systems and Energy Storage Verification. When on-site power production, off-site power production, or energy storage is ~~present and~~ used for compliance, the following shall be verified:

a. All minimum requirements of Section 6.3.
b. The on-site power production system and/or energy storage system is installed in accordance with the configuration and performance characteristics modeled in the proposed design.
c. Reports are available for the off-site power production system and energy storage system demonstrating they are operational, have the stated capcity installed, and have the stated energy storage system capacity installed (if applicable).
d. Documentation that shall demonstrate that not less than 15 years of annual renewable energy production capacity and energy storage capacity used to comply with this standard is legally bound to the dwelling-unit owner and is structured to survive a full or partial transfer of ownership of the dwelling unit.

Modify Section 9 as shown.

9.1.5 ~~On-Site~~ Renewable Energy System Generation. Verification, in accordance with Section 6.3, of on-site power production included in the *proposed design* or as-built construction shall be reported in accordance with Section 8.7.

[. . .]

9.1.6.1 For the Building Permit Compliance Report and the Certificate of Occupancy Compliance Report, component characteristics for the *proposed design* and as-built construction, respectively, shall be confirmed to meet or exceed the requirements of Section 6.1.

a. The third-party-tested building envelope air leakage test results shall be reported in the Certificate of Occupancy Compliance Report.
b. For projects in which the *proposed design* or as-built construction includes ~~on-site r~~ Renewable Energy System ~~generation~~ credit for the *ERI* performance calculation, component characteristics shall be confirmed to meet the requirements of Section 6.3.1.
c. Third-party-tested building envelope air leakage test results shall be reported and shall be confirmed to meet the requirements of Section 6.3.2**.**

[. . .]

9.1.10 The achieved CO_2e Index of the proposed design and the as built construction, calculated according to Equation 8-1 of ANSI/RESNET/ICC Standard 301-2022 Addendum B-2022 shall be reported to be equal to or less than ~~55~~Tables 6-1 and 6-2.

Modify Normative Appendix D, Section D1.2 as shown.

D1.2 Installed insulation materials, amounts, and locations shall comply with *the proposed design*. In no case shall installed insulation amounts be less than those required to deliver the maximum U-factors defined in Tables 6-~~2~~3 or 7-1, as applicable.

Modify Informative Appendix E, Section E1 as shown.

E1. PRESCRIPTIVE COMPLIANCE GUIDES

Prescriptive compliance guides shall comply with this standard, including Section 6 and applicable requirements of Section 7, and shall be generated in accordance with either Section E1.1, Section E1.2, or Section E1.3. In all cases, prescriptive guidelines shall comply with the provisions of Section 7.1.1 of the standard, and, where Renewable Energy Systems are ~~on-site power production is~~ incorporated, prescriptive guidelines shall comply with Section 6.3.1 of the standard.

Modify Informative Appendix I, Table I-1 as shown.

INFORMATIVE APPENDIX I
PLAN REVIEW INSPECTION CHECKLIST

Table I-1 Sample Plan Review Inspection Checklist

[. . .]		
Modeling Compliance		Notes
Name and version of the simulation program employed listed	☐ Yes ☐ No	
The *proposed design* adheres to the modeling rule set defined in Section 6.2 (unless on-site power production or off-site power production is being utilized).	☐ Yes ☐ No	
The *proposed design* meets the *ERI* appropriate for its climate zone, per Table 6-1.	☐ Yes ☐ No	
Renewable Energy System~~On-Site Power Production~~		Notes
On-site power production system or off-site power production system defined, including *renewable energy* source and projected kW output	☐ Yes ☐ No	
Complies with *the building thermal envelope* elements in Table 6-~~2~~3	☐ Yes ☐ No	
[. . .]		

Modify Informative Appendix J as shown.

Table J-1 Sample Site Inspection Checklist

[. . .]		
The following characteristics match the *proposed design*.		Notes
Orientation	☐ Yes ☐ No	
U-factor and SHGC values	☐ Yes ☐ No	
Insulation R-values	☐ Yes ☐ No	
Duct construction	☐ Yes ☐ No	
Pipe construction	☐ Yes ☐ No	
On-site power systems or off-site power systems (if applicable)	☐ Yes ☐ No	
[. . .]		

Add new Informative Appendix L as shown.

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INFORMATIVE APPENDIX L
NET ZERO APPENDIX

Where a jurisdiction determines that zero energy or zero carbon buildings are required, the following criteria shall be met.

a. All residential dwelling units shall meet all the requirements of this standard and achieve either an *ERI* of 0 or lower or a CRI of 0 or lower.
b. A building or dwelling unit that meets the *ERI* requirement can be represented as a net zero energy unit.
c. A building or dwelling unit that meets the CRI requirement can be represented as a net zero carbon unit.

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

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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.

ASHRAE · 180 Technology Parkway NW · Peachtree Corners, GA 30092 · www.ashrae.org

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