ADDENDA

ANSI/ASHRAE/IES Addendum cn to
ANSI/ASHRAE/IES Standard 90.1-2022

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

Approved by ASHRAE and the American National Standards Institute on December 5, 2025, and by the Illuminating Engineering Society on December 3, 2025.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

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FOREWORD

Addendum cn adds one additional energy credit for HVAC heating thermal storage systems and updates the current energy credit for HVAC cooling thermal storage based on additional studies performed by PNNL.

The new heating thermal storage credit builds upon the existing energy credit for HVAC cooling thermal storage: 11.5.2.8.5 G05.

Thermal storage is a necessary component of HVAC systems to enable matching the building load (use of energy) to the production of energy, either by collecting waste heat or by using energy when it is produced with the lowest marginal impact. This can target either times of low-cost energy production or periods of energy production that are dominated by renewable energy sources. ISOs have indicated that without energy storage, there will be grid problems in the future. This already happens in California where solar energy production is often curtailed due to the mismatch between times of energy production and energy demand.

There are opportunities to solve these challenges, using both grid-level and local- or building-level energy storage, which will enable additional renewable energy production. And within the local-level storage there are opportunities for both direct electrical storage and for thermal storage. A balanced approach that fits the economic, footprint, and local code needs will accelerate renewable energy the fastest. For these reasons, thermal storage is included in the tax credits associated with recent legislation.

The HVAC Cooling Energy Storage credit G05 currently provides credits for systems that are sized between 0.5 and 4.0 ton-hours per ton of design day of cooling. Larger systems are acceptable, but no credits are given for a larger system. Additional analysis by the PNNL team shows that 5.0 ton-hours per ton of storage is still very effective, but effectiveness tends to drop off after that. Addendum cn changes from a maximum of 4.0 to 5.0 ton-hours storage per ton. Users can design for systems with larger thermal storage capacities, but credits will be earned only up to 5.0 ton-hours storage per ton.

The new HVAC Heating Energy Storage credit will provide comparable credits for similar-sized systems designed for heating energy storage. If a system (such as a large water tank) is capable of and configured to meet both cooling and heating storage, then the building can earn credit for both since it is reducing peek energy or allowing expanded use of renewable energy in both circumstances.

Both systems have been evaluated or re-evaluated by PNNL, and Tables 11.5.3-1 through 11.5.3-9 have been updated accordingly.

Addendum cn has been subjected to the same cost considerations as all other energy credit addenda to develop the recommended credit values in Tables 11.5.3-1 through 11.5.3-9. By adding an additional option to the energy credits, this addendum creates additional flexibility that should reduce the cost of complying with Section 11 for those who decide to select these energy credit options.

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 cn to Standard 90.1-2022

Modify Section 11.5.2.8.5 as shown (I-P and SI). NOTE: This addendum includes duplicates of markup made by Addendum ca2, and changes made by this addendum further modify Addendum ca2.

[. . .]

11.5.2.8.5 G05: HVAC Cooling Energy Storage. To achieve this credit, ice or chilled-water storage *equipment* shall be installed and load management controls configured to reduce electric cooling peak *demand*, shift load to match regional generation of renewable *energy*, or shift load to match favorable outdoor ambient conditions that reduce overall *energy* consumption. Storage ~~tank(s)~~ container(s) shall be demonstrated through analysis to have less than 2% loss of stored capacity over a 24-hour period for the cooling design day.

Base *energy* credits in Section 11.5.3 are for storage capacity of 1.0 ton-hours (kWh) storage per ton (kW) of design-day peak cooling load with a 1.15 sizing factor. ~~Prorate *energy*~~ *Energy* credits for ~~other~~ installed storage *systems* sized between 0.5 and ~~4.0~~ 5.0 ton-hours (kWh) storage per ton (kW) of design-day peak cooling load shall be prorated. Larger storage shall be permitted; however, prorated credits ~~are~~ shall be

limited by a storage ratio no greater than ~~to 4.0~~ 5.0 ton-hours (kWh) storage per ton (kW) of design-day peak cooling load. The capacity of the thermal storage device shall be provided by the manufacturer of the device on the *construction documents* submitted for permitting. ~~Energy~~ Prorated *energy* credits shall be determined as follows:

$$EC_{G05\_adj} = EC_{G05\_base} \times ChlrTypeMult \times (0.099 + 0.986 \times SR - 0.085 \times SR^2)$$

~~$$EC_{G05\_adj} = EC_{G05\_base} \times \frac{(1.44 \times SR + 0.71)}{2.15}$$~~

where

EC_{G05_adj} = *energy* credits achieved for HVAC cooling *energy* storage

EC_{G05_base} = G05 base *energy* credit for *building* use type and climate zone based on ton-hours (kWh) storage per ton (kW) of design-day peak cooling load

ChlrTypeMult = 1.0 for water-cooled chillers

= 1.74 for air-cooled chillers in Climate Zones 0B, 1B, 2B, 3B, 4B, 5B, 6B

= 1.34 for air-cooled chillers in all other climate zones

SR = storage ratio in ton-hours (kWh) storage per ton (kW) of design-day peak cooling load, where $0.5 \le SR \le$ ~~4.0~~ 5.0

Informative Notes:

1. Where the thermal storage *system* is capable of and configured to provide storage for heating and cooling, load management credits may be claimed for both Sections 11.5.2.8.5 and 11.5.2.8.10. AHRI 900 can be utilized for the testing and rating of thermal storage *equipment* used for cooling, which may be charged and discharged with any variety of heat transfer fluids, including thermal storage using water, ice on coil, encapsulated ice, phase-change material, ice harvester chiller, ice slurry, or unitary. Measure G05 base *energy* credit values in Section 11.5.3 are based on a storage capacity of 1.0 ton-hours (kWh) storage per ton (kW) of design-day peak cooling load with a 1.15 sizing factor.
2. Different cooling and heating system types achieve different thermal storage energy credits based on the relative energy cost savings when thermal storage is applied to that system. The energy usage of these systems without thermal storage is not equal. Therefore, thermal storage energy credits should not be the sole criterion for selecting a cooling or heating system.

Add Section 11.5.2.8.10 as shown (I-P and SI).

[. . .]

11.5.2.8.10 G010: HVAC Heating Energy Storage. To achieve this credit, stored heating thermal *energy* must be generated by electrical means. Thermal *energy* storage heating *equipment* shall be installed and load management controls configured to reduce electric heating peak *demand*, shift load to match regional generation of renewable *energy*, or shift load to match favorable outdoor ambient conditions that reduce overall *energy* consumption. Storage container(s) shall be demonstrated through analysis to have less than 2% loss of stored capacity over a 24-hour period for the heating design day.

Energy credits for installed storage *systems* sized between 0.5 and 4.0 MBtu (kWh) storage per MBtu/h (kW) of design-day peak heating load shall be prorated. Larger storage shall be permitted; however, prorated credits shall be limited by a storage ratio no greater than 4.0 MBtu (kWh) storage per MBtu/h (kW) of design-day peak heating load. The capacity of the thermal storage device provided by the manufacturer shall be specified in the *construction documents* submitted for permitting. Prorated *energy* credits shall be determined as follows:

$$EC_{G10\_adj} = EC_{G10\_base} \times HeatTypeMult \times (0.198 + 0.545 \times SR - 0.072 \times SR^2)$$

where

EC_{G10_adj} = *energy* credits achieved for HVAC heating *energy* storage

EC_{G10_base} = G10 base *energy* credit for *building* use type and climate zone based on MBtu (kWh) storage per MBtu/h (kW) of design-day peak heating load

HeatTypeMult = 1.0 for electric resistance heating

= 0.42 for heat-pump heating in Climate Zones 0 to 4, 5A, and 5C

= 0.57 for heat-pump heating in Climate Zones 5B, 6A, 6B, 7, and 8

SR = storage ratio in MBtu (kWh) storage per MBtu/h (kW) of design-day peak heating load, where $0.5 < SR < 4.0$

Informative Notes:

1. Where the thermal storage *system* is capable of and configured to provide storage for heating and cooling, load management credits may be claimed for Sections 11.5.2.8.5 and 11.5.2.8.10. Measure G10 base *energy* credit values in Section 11.5.3 are based on storage capacity of 2.0 MBtu (kWh) storage per MBtu/h (kW) of design-day peak heating load with a 1.15 sizing factor.
2. Different cooling and heating system types achieve different thermal storage energy credits based on the relative energy cost savings when thermal storage is applied to that system. The energy usage of these systems without thermal storage is not equal. Therefore, thermal storage energy credits should not be the sole criterion for selecting a cooling or heating system.

Modify Tables 11.5.3-1 through 11.5.3-9 as shown. Rows not shown are unchanged.

Table 11.5.3-1 Energy Credits for Multifamily

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
[. . .]																					
~~G05~~	~~HVAC Cooling Energy Storage~~	~~11.5.2.8.5~~	~~22~~	~~5~~	~~27~~	~~12~~	~~19~~	~~18~~	~~19~~	~~33~~	~~10~~	~~11~~	~~20~~	~~9~~	~~7~~	~~14~~	~~8~~	~~6~~	~~15~~	~~1~~	~~3~~
G05	HVAC Cooling Energy Storage	11.5.2.8.5	21	23	22	23	23	18	18	16	14	17	14	12	14	13	11	14	11	14	9
[. . .]																					
G10	HVAC Heating Energy Storage	11.5.2.8.10	0	0	0	0	1	1	8	4	3	12	4	9	13	10	6	27	19	24	27

× = Credits excluded from this *building* use type and climate zone.

Table 11.5.3-2 Energy Credits for Health Care Buildings

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
[. . .]																					
~~G05~~	~~HVAC Cooling Energy Storage~~	~~11.5.2.8.5~~	~~9~~	~~2~~	~~12~~	~~5~~	~~9~~	~~7~~	~~10~~	~~14~~	~~10~~	~~6~~	~~8~~	~~7~~	~~5~~	~~7~~	~~5~~	4	~~8~~	~~1~~	~~1~~
G05	HVAC Cooling Energy Storage	11.5.2.8.5	17	17	16	16	17	13	15	13	14	16	11	12	13	10	10	14	10	13	6
[. . .]																					
G10	HVAC Heating Energy Storage	11.5.2.8.10	1	2	2	3	6	5	9	7	11	14	9	17	15	14	13	24	17	25	30

× = credits excluded from this *building* use type and climate zone.

Table 11.5.3-3 Energy Credits for Hotel/Motel

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
[. . .]																					
~~G05~~	~~HVAC Cooling Energy Storage~~	~~11.5.2.8.5~~	~~18~~	~~5~~	~~25~~	~~11~~	~~19~~	~~17~~	~~22~~	~~33~~	~~20~~	~~14~~	~~19~~	~~12~~	~~12~~	~~16~~	~~8~~	~~9~~	~~19~~	~~2~~	~~3~~
G05	HVAC Cooling Energy Storage	11.5.2.8.5	14	16	14	16	15	13	15	12	12	17	12	14	16	12	13	18	13	16	11
[. . .]																					
G10	HVAC Heating Energy Storage	11.5.2.8.10	0	0	0	0	1	1	3	3	1	6	6	6	9	10	8	14	15	20	29

× = credits excluded from this *building* use type and climate zone.

Table 11.5.3-4 Energy Credits for Office Buildings

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
[. . .]																					
~~G05~~	~~HVAC Cooling Energy Storage~~	~~11.5.2.8.5~~	~~22~~	~~6~~	~~29~~	~~13~~	~~21~~	~~19~~	~~22~~	~~37~~	~~22~~	~~13~~	~~21~~	~~12~~	~~12~~	~~16~~	~~8~~	~~9~~	~~20~~	~~2~~	~~3~~
G05	HVAC Cooling Energy Storage	11.5.2.8.5	33	37	34	36	37	34	32	27	31	33	24	18	29	19	14	26	18	28	11
[. . .]																					
G10	HVAC Heating Energy Storage	11.5.2.8.10	0	0	0	1	2	2	15	10	2	27	13	24	33	27	28	54	43	46	58

× = credits excluded from this *building* use type and climate zone.

Table 11.5.3-5 Energy Credits for Restaurant Buildings

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
[. . .]																					
~~G05~~	~~HVAC Cooling Energy Storage~~	~~11.5.2.8.5~~	~~4~~	~~1~~	~~5~~	~~2~~	~~4~~	~~3~~	~~4~~	~~6~~	~~2~~	~~2~~	~~3~~	~~1~~	~~1~~	~~2~~	~~×~~	~~1~~	~~2~~	~~×~~	~~×~~
G05	HVAC Cooling Energy Storage	11.5.2.8.5	16	19	15	18	18	15	14	14	13	13	11	9	10	9	8	11	8	11	5
[. . .]																					
G10	HVAC Heating Energy Storage	11.5.2.8.10	0	0	0	2	2	5	10	9	9	17	12	17	31	20	21	32	29	56	61

× = credits excluded from this *building* use type and climate zone.

Table 11.5.3-6 Energy Credits for Retail Buildings

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
[. . .]																					
~~G05~~	~~HVAC Cooling Energy Storage~~	~~11.5.2.8.5~~	~~24~~	~~6~~	~~35~~	~~15~~	~~26~~	~~23~~	~~28~~	~~40~~	~~18~~	~~15~~	~~23~~	~~9~~	~~10~~	~~16~~	~~3~~	~~8~~	~~16~~	~~2~~	~~2~~
G05	HVAC Cooling Energy Storage	11.5.2.8.5	27	31	27	31	30	26	26	25	25	24	21	18	19	17	17	20	16	20	11
[. . .]																					
G10	HVAC Heating Energy Storage	11.5.2.8.10	0	0	0	2	1	2	12	8	3	22	13	24	26	26	26	39	35	48	55

× = credits excluded from this *building* use type and climate zone.

Table 11.5.3-7 Energy Credits for Education Buildings

ID	Energy Credit Abbreviated Title	Section	Climate Zone																		
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
[. . .]																					
~~G05~~	~~HVAC Cooling Energy Storage~~	~~11.5.2.8.5~~	~~26~~	~~7~~	~~37~~	~~17~~	~~30~~	~~28~~	~~36~~	~~40~~	~~38~~	~~23~~	~~37~~	~~22~~	~~20~~	~~28~~	~~13~~	~~16~~	~~32~~	~~3~~	~~4~~
G05	HVAC Cooling Energy Storage	11.5.2.8.5	24	28	23	27	23	25	18	21	23	22	17	13	18	16	12	23	12	15	8
[. . .]																					
G10	HVAC Heating Energy Storage	11.5.2.8.10	1	0	4	1	8	1	18	5	5	12	9	19	18	21	19	25	18	31	44

× = credits excluded from this *building* use type and climate zone.

Table 11.5.3-8 Energy Credits for Warehouses

ID	Energy Credit Abbreviated Title	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
[. . .]																					
~~G05~~	~~HVAC Cooling Energy Storage~~	~~11.5.2.8.5~~	~~40~~	~~15~~	~~40~~	~~32~~	~~40~~	~~40~~	~~32~~	~~40~~	~~17~~	~~12~~	~~26~~	~~4~~	~~5~~	~~12~~	~~1~~	~~3~~	~~7~~	~~×~~	~~×~~
G05	HVAC Cooling Energy Storage	11.5.2.8.5	30	35	28	34	30	28	17	22	13	12	13	3	5	6	1	3	2	2	0
[. . .]																					
G10	HVAC Heating Energy Storage	11.5.2.8.10	0	0	0	0	0	1	28	11	1	71	46	47	70	71	45	96	84	95	83

× = credits excluded from this *building* use type and climate zone.

Table 11.5.3-9 Energy Credits for Other Buildings

ID	Energy Credit Abbreviated Title	Section	Climate Zone																	
			0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
[. . .]																					
~~G05~~	~~HVAC Cooling Energy Storage~~	~~11.5.2.8.5~~	~~21~~	~~6~~	~~26~~	~~13~~	~~21~~	~~19~~	~~22~~	~~30~~	~~17~~	~~12~~	~~20~~	~~10~~	~~9~~	~~14~~	~~7~~	~~7~~	~~15~~	~~2~~	~~3~~
G05	HVAC Cooling Energy Storage	11.5.2.8.5	23	26	22	25	24	22	19	19	18	19	15	12	16	13	11	16	11	15	8
[. . .]																					
G10	HVAC Heating Energy Storage	11.5.2.8.10	0	0	1	1	3	2	13	7	4	23	14	20	27	25	21	39	33	43	48

× = credits excluded from this *building* use type and climate zone.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

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.

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

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