_____Public Review Draft

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

**First Public Review (April 2025)
(Draft Shows Proposed Changes to Current Standard)**

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

This standard is under continuous maintenance. To propose a change to the current standard, use the change submittal form available on the ASHRAE website, www.ashrae.org.

ASHRAE, 180 Technology Parkway NW, Peachtree Corners, GA 30092

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

This addendum 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 effectivity tends to drop off after that. This addendum proposes changing 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 the tables 11.5.3-1 through 11.5.3-9 have been updated accordingly.

Cost Considerations: This addendum has been run through the same cost considerations as all other energy credit addendum, 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 is creating additional flexibility that should reduce the cost of complying with Chapter 11 for those who decide to select these energy credit options.

[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 cn to 90.1-2022

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:

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

$$\sout{EC_{G05\_adj} = EC_{G05\_base} \text{ x } \frac{(1.44 \text{ x SR} + 0.71)}{2.15}}$$

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 $0.5 \leq \text{SR} \leq$ ~~4.0~~ 5.0

Informative Note: 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.

Add section 11.5.2.8.10 as follows:

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/hr (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/hr (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/hr (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/hr (kW) of design-day peak heating load, where $0.5 \leq SR \leq 4.0$

Informative Note: 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/hr (kW) of design-day peak heating load with a 1.15 sizing factor.

Modify tables 11.5.3-1 through 11.5.3-9 as follows. Rows not shown are unchanged:

Table 11.5.3-1 Energy Credits for Multifamily

ID	Energy Credit Abbreviated Title	Section	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	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~~

ID	Energy Credit	Section																			
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

ID	Energy Credit	Section																					
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 Warehouse 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~~	~~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.

The test below shows the changes in this addendum relative to addendum CA which is out for public review. All CA changes are shown as accepted. Strike out and underling is only changes relative to CA.

Modify Section 11.5.2.8.5 as follows:

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~~ *energy,* or shift load to match favorable outdoor ambient conditions that reduce overall ~~energy~~ *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 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. *Energy* credits for installed storage *systems* sized between 0.5 and 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 shall be limited by a storage ratio no greater than 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~~ *construction documents* submitted for permitting. Prorated *energy* credits shall be determined as follows:

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

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

~~W~~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) ~~(kW-hr storage per kW)~~ of design-day peak cooling load
<u>ChlrTypeMult</u>	= <u>1.0 for water cooled chillers</u>
	<u>1.74 for air cooled chillers in climate zones 0B, 1B, 2B, 3B, 4B, 5B, 6B</u>
	<u>1.34 for air cooled chillers in all other climate zones</u>
SR	= storage ratio in ton-hours (kWh) storage per ton (kW) of design-day peak cooling load, where $0.5 \leq SR \leq 5.0$

Informative Note: Where the thermal storage ~~system~~ *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~~ *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.

Add section 11.5.2.8.10 as follows:

11.5.2.8.10 G010: HVAC Heating Energy Storage. To achieve this credit, stored heating thermal ~~energy~~ *energy* must be generated by electrical means. Thermal ~~energy~~ *energy* storage heating ~~equipment~~ *equipment* shall be installed and load management controls configured to reduce electric heating peak ~~demand~~ *demand*, shift load to match regional generation of renewable ~~energy~~ *energy*, or shift load to match favorable outdoor ambient conditions that reduce overall ~~energy~~ *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~~ *systems* sized between 0.5 and <u>4.0</u> ~~5.0~~ MBTU (kWh) storage per MBTU/hr (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 <u>4.0</u> ~~5.0~~ MBTU (kWh) storage per MBTU/hr (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~~ *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~~ *energy* storage
EC_{G10_base}	= G10 base ~~energy~~ *energy* credit for ~~building~~ *building* use type and climate zone based on MBTU <u>(kWh)</u> storage per MBTU/hr <u>(kW)</u> ~~(kW-hr storage per kW)~~ of design-day <u>peak</u> 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 <u>(kWh)</u> storage per MBTU/hr <u>(kW)</u> ~~(kW-hr storage per kW)~~ of design-day peak heating load, where $0.5 \leq SR \leq$ <u>4.0</u> ~~5.0~~

Informative Note: Where the thermal storage ~~system~~ *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~~ *energy* credit values in Section 11.5.3 are based on storage capacity of 2.0 MBTU (kWh) storage per MBTU/hr (kW) of design-day peak heating load with a 1.15 sizing factor.