BSR/ASHRAE/IES Addendum BK
to ANSI/ASHRAE/IES Standard 90.1-2022

Public Review Draft

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

Second Public Review (May 2025)
(Draft Shows Proposed Changes to Current Standard)

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FOREWORD

This addendum establishes requirements that air-cooled and air-source HVAC systems that serve building areas that are both heated and cooled utilize electric or fuel-fired heat pumps as the initial heat source. The addendum cost-effectively reduces energy usage and greenhouse emissions associated with providing space heating and cooling through proven and effective equipment and systems.

The addendum includes requirements for buildings with air-cooled and air-source cooling equipment following Section 6.5, “Prescriptive Compliance Path,” or Section 6.3, “Simplified Approach Building Compliance Path for HVAC Systems.” Although analysis indicates cost-effective energy and emissions reductions at different electric heat pump design temperatures, this addendum ensures that, for systems using electricity as the initial heat source, electric heat pump capacity is not required to exceed the cooling system load; it provides for smaller heat pump capacity where it is sufficient to meet the building heating load or where the use of other system designs (e.g. integrated on-site renewable energy, site-recovered energy or thermal energy storage) allows the heating capacity to be reduced.

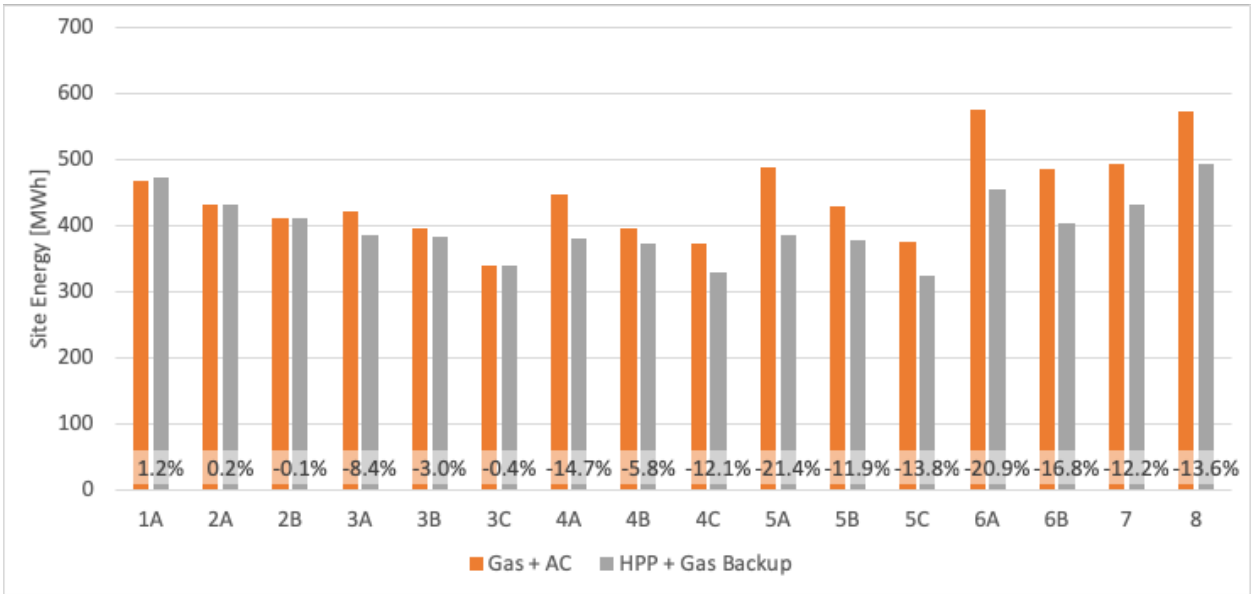
A second compliance path for systems using fuels as the initial heat source requires the use of fuel-fired heat pumps (e.g. gas heat pumps). The cost-effectiveness analysis underlying this addendum is based on electric heat pumps; as adequate gas heat pump cost data is unavailable, the gas heat pump performance requirements aim for similar performance between the electric and gas heat pump options based on the cost of fuels, including SSPC 90.1’s approved social costs of greenhouse gas emissions (SC-GHG).

There are, in fact, numerous other higher performing systems that go beyond the minimum requirements in this addendum, in addition to the many proven technologies and system designs that meet its requirements.

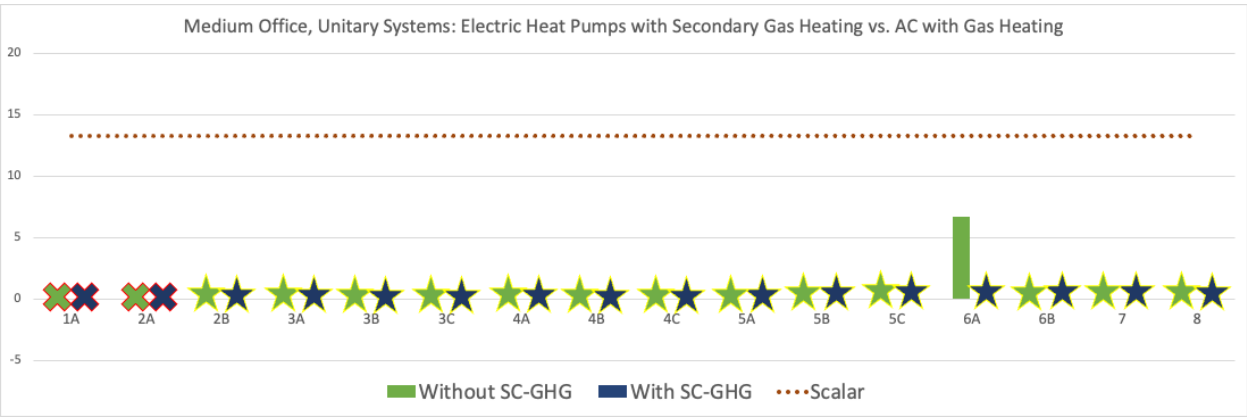
Configurations that use secondary heat from other equipment (such as those using electric resistance or fuels) is allowed where heat pumps (or on-site renewable energy or site-recovered energy) cannot provide the necessary heating to satisfy the load. The addendum also includes an exception that allows the heating system to be configured to reduce energy costs based on the actual utility tariffs and utility programs available to the building. Further exceptions are included for space heating loads that may be difficult to serve with heat pumps.

For certain systems where the minimum cooling efficiency for heat pumps is less than the minimum cooling efficiency for air-conditioners, cooling energy may be higher; an exception is also included for climate zones where these effects negatively impact cost-effectiveness.

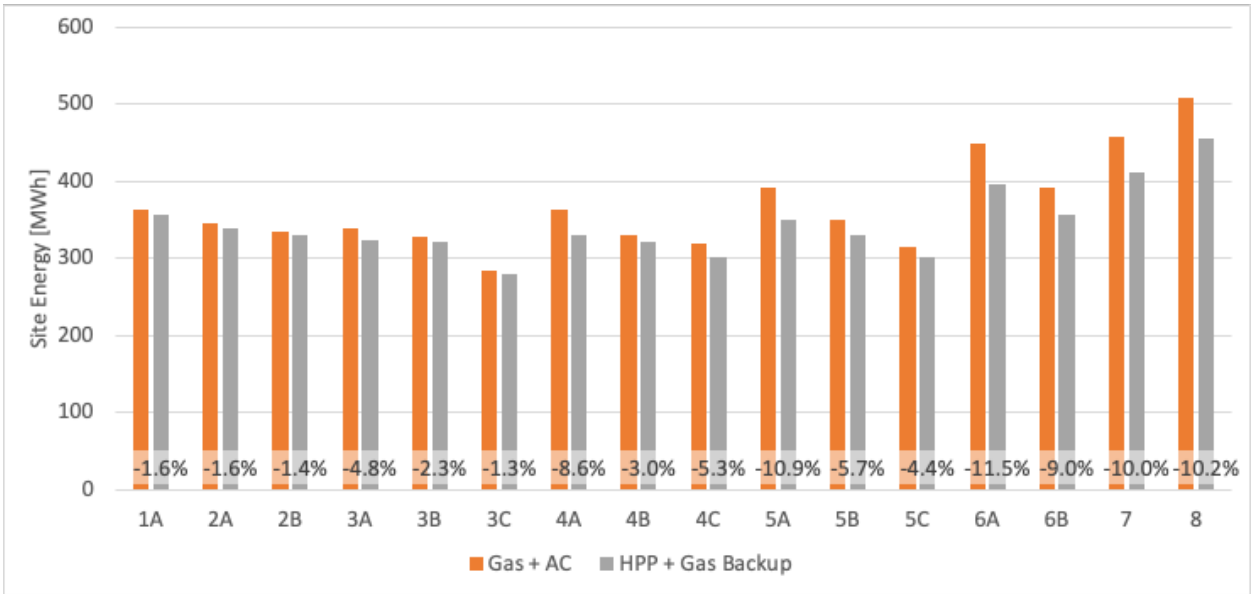
The typical ASHRAE 90.1 scalar analysis is not particularly insightful because of the closeness in costs associated with AC + Gas Furnace and Heat Pump systems. The research and analysis supporting this addendum found total installed costs to be about the same, though energy are significant from the heat pump primary systems. Computed potential energy savings from this addendum are shown in the following figure for the prototype medium office building:



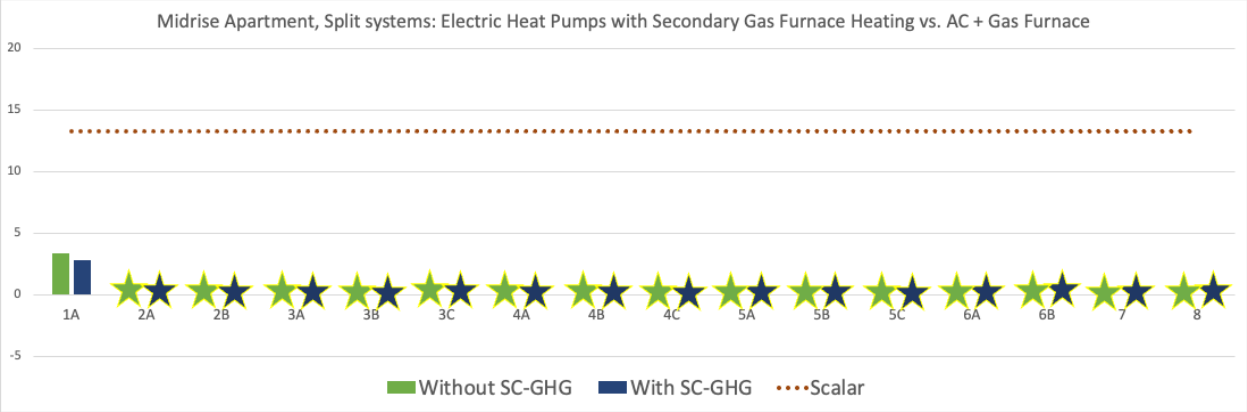
Despite the caveats above, life cycle cost analyses were performed that show the following for systems with (1) initial heating from minimum efficiency air-source heat pumps with a cooling capacity of not less than 65,000 Btu/h that meet the sizing requirements of this addendum and (2) secondary heating from minimum efficiency natural gas furnaces (here stars indicate lower first and annual costs, X's indicate increases in greenhouse gas emissions due to lower cooling efficiencies for heat pumps vs. air-conditioners):



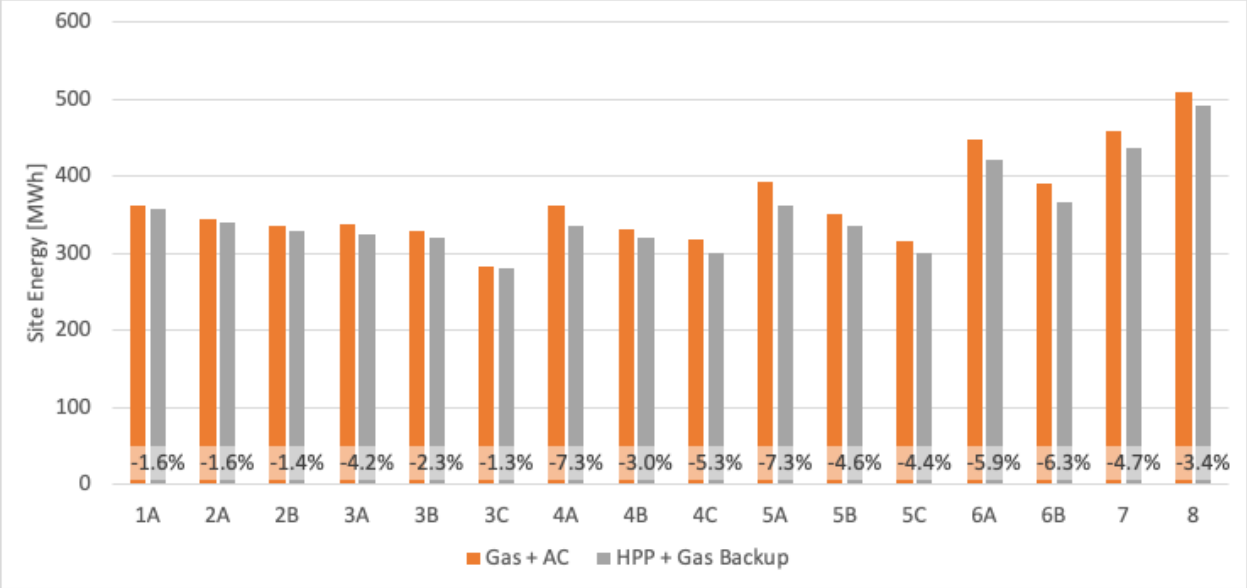
There is more nuance to the analysis for residential split systems because the total installed cost for Central AC + Gas Furnace ($710/kW heating capacity) is higher than for a HP-only system ($645/kW), but the total installed cost of a HP + Gas Furnace heat pump primary system is highly sensitive to the heating capacity of both the HP and the gas furnace. As an upper bound, if both the HP and gas furnace are sized to meet the full heating load, the total installed cost would be $760/kW, but this is mitigated by the sizing of the heat pump to partial load. Where initial heating is provided by a minimum efficiency split-system electric heat pump that meets the sizing requirements of this addendum and secondary heating is provided by a natural gas furnace provides secondary space heating where an electric heat pump cannot provide the necessary heating energy to satisfy the thermostat setting, the computed potential energy reductions are significant:



Life cycle cost analyses show the following for split systems for the prototype midrise apartment building (here stars indicate lower first and annual costs, X's indicate increases in greenhouse gas emissions due to lower cooling efficiencies for heat pumps vs. air-conditioners):



As traditional residential system configurations may not allow simultaneous heating from electric heat pumps and fuels, an additional analysis is presented for the midrise apartment building where there is a fully redundant natural gas furnace in addition to the heat pump, with the following computed potential energy reductions:



Taken together, this addendum represents a low-cost approach to very significant energy and emissions reductions, with flexibility for how individual designers and building projects achieve the intent of the addendum.

[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 bk to 90.1-2022

Add following section:

6.1.4.6 *Alterations* of *space* heating or *space* cooling *equipment* listed in the applicable tables of Section 6.8.1 that account for not less than 50% of the *space* heating or *space* cooling capacity serving a *building* or *alteration* area that is both heated and cooled shall comply with Section 6.5.12.

Exceptions to 6.1.4.6:

1. *Alterations* that are limited to new or replacement heat rejection *equipment* listed in Table 6.8.1-7, fan-coil units, or *terminal* units.
2. Where *alterations* comprise a replacement of a *unitary air-conditioner* and the existing and replacement *unitary air-conditioners* have a rated cooling capacity greater than 816,000 Btu/h (239kW) such replacements need not comply.
3. Replacement of *boilers*, furnaces, duct heaters or unit heaters where a cooling system is not altered.

Add the following to Section 6.3.2:

u. The *system* complies with Section 6.5.12.

Add the following new Section 6.5.12:

6.5.12 Air-to-Air HVAC systems. *HVAC systems* that serve *spaces* that are both heated and cooled and where the cooling load is served by any of the following shall comply with Sections 6.5.12.1 and 6.5.12.2:

a. Air-cooled or air-source *equipment* listed in Tables 6.8.1-1, 6.8.1-2, 6.8.1-8, 6.8.1-9, 6.8.1-13 or 6.8.1-14; or
b. *Equipment* listed in Table 6.8.1-4.

Exceptions to 6.5.12:

1. Where *unitary air conditioners* with a rated cooling capacity of not less than 65,000 Btu/h (19 kW) are used in Climate Zones 0A, 0B, 1A, 1B, 2A, 2B and 3C.
2. *Additions* where the new *spaces* are served by existing *equipment*.
3. Multiple zone HVAC systems that comply with all of the following:
   a. For each zone in the system, the primary airflow rate in heating does not exceed the rate required to meet the Simplified Procedure ventilation requirements of ASHRAE Standard 62.1 or the ventilation requirements of ANSI/ASHRAE/ASHE Standard 170 as applicable for the zone based on the *design minimum outdoor air rate*; and
   b. The mixed air temperature on the design heating day at the *system* design airflow is greater than the maximum supply air temperature required by section 6.5.3.5.

6.5.12.1 Initial space heating. *HVAC systems* shall comply with Section 6.5.12.1.1 and Section 6.5.12.1.2.

6.5.12.1.1 Electric space heating. *HVAC systems* using electricity as the initial space heating source shall comply with one of the following:

i. The *HVAC system* electric heat pump heating capacity rated at 47ºF in accordance with the applicable test procedure in Section 6.8.1 shall be no less than the system cooling design load; or

ii. The *HVAC system* electric heat pump heating capacity under heating design conditions shall be no less than the system heating design load.

Exceptions to 6.5.12.1.1:

1. HVAC *systems* using no heat source other than electric heat pumps*, on-site renewable energy*, *site-recovered energy*, or electric resistance or *fuel* heating where allowed by any exceptions to Section 6.5.12.2.
2. Where *Buildings* are served by a single electric heat pump, the heat pump heating capacity shall be permitted to be no less than 90% of the *system* cooling design load.
3. Electric heat pump heating capacity shall be permitted to be reduced by the total capacity of electric resistance heat complying with Exceptions 10 through 13 to Section 6.5.12.2.

6.5.12.1.2 Fuel space heating. *HVAC systems* using *fuels* as the initial space heating source shall include *fuel*-fired heat pumps sized to meet the heating *system* design load in accordance with Section 6.4.2.1

and with a minimum *coefficient of performance* no less than the applicable values in Table 6.5.12.1.2 at 17°F (-8.3°C) *outdoor air* temperature when tested in accordance with CSA/ANSI Z21.40.4.

Table 6.5.12.1.2.1 Minimum Fuel-Fired Heat Pump Efficiency

Equipment Sizing Category (Input)	Minimum *COP* at 17°F (-8.3°C) Outdoor Air Temperature
<65,000 Btu/h (19 kW)	1.10
≥65,000 Btu/h (19 kW)	1.20

6.5.12.2 Secondary space heating. *HVAC systems* shall be configured to use secondary electric resistance or fuel space heating *systems* and *equipment* only when *systems* and *equipment* meeting the requirements of Section 6.5.12.1, *on-site renewable energy,* or *site-recovered energy* cannot provide the necessary heating energy to satisfy the heating load.

Exceptions to 6.5.12.2:

1. Where *HVAC systems* are configured to use secondary space heating *systems* and *equipment* when they can provide the necessary heating energy to satisfy the heating load at lower energy cost than the initial space heating *systems* and *equipment* and where the *building* has any of the following:
    a. An *automatic control device* programmed to operate space heating *systems* and *equipment* based on the *outdoor air* temperature and a fixed price or time-of-use price schedule applicable to the *building*.
    b. A *DDC system* programmed to operate space heating *systems* and *equipment* based on the *outdoor air* temperature and one or more of the following from the *building*'s utility or energy provider:
        i. A *demand* response program
        ii. Real-time or next-day pricing
        iii. A time-of-use price schedule
        iv. A *demand* charge
2. *Systems* that comprise less than 5 percent of the *building*'s total installed heating capacity or that serve less than 5 percent of the *building*'s *conditioned floor area*.
3. Space heating *systems* sized and configured for freeze protection in *spaces* with indoor design conditions of not greater than 40°F (4.5°C), including temporary systems in unfinished spaces.
4. Freeze protection systems complying with Section 6.4.3.7.
5. *Systems* and *equipment* that preheat *outdoor air* for defrost or to temper air entering an energy recovery device, and that comply with one of the following:

a. Where the *system* recovers latent energy, where the *space* is mechanically humidified or has a process application that will maintain the space above 30% relative humidity when the outdoor temperature is not greater than 25°F (-4.0°C), and where the *outdoor air* is preheated to no greater than 25°F (-4.0°C).
b. Where the *system* recovers only sensible energy, and where the *outdoor air* is preheated to no greater than 25°F (-4.0°C).
c. Where *outdoor air* is preheated to no greater than 5°F (-15°C).

6. *Systems* and *equipment* that heat exhaust air for frost control in an exhaust air energy recovery device, and that comply with one of the following:
    a. Where the system recovers latent energy, where the space is mechanically humidified or has a process application that will maintain the space above 30% relative humidity when the outdoor temperature is not greater than 25°F (-4.0°C), and where the exhaust air is heated to no greater than 110°F (43°C).
    b. Where the system recovers only sensible energy and where the exhaust air is heated to no greater than 110°F (43°C).
    c. Where exhaust air is heated to no greater than 90°F (32°C).
7. Hydronic *systems* without energy recovery ventilation, that do not use freeze protection fluids and where *outdoor air* is preheated to no greater than 40°F (4.5°C).
8. Where the added heating load of commercial kitchen exhaust system *makeup air* exceeds the heating capacity of the *HVAC system*, provided that *systems* and *equipment* that do not comply with the requirements of Section 6.5.12.1 are used only to maintain a temperature differential of no more than 10°F (5.6°C) between makeup air and the air in the conditioned space.
9. *Systems* serving portions of *buildings* that cannot be served by *systems* and *equipment* meeting the requirements of Section 6.5.12.1, as determined and approved by the *authority having jurisdiction*.
10. *Electric resistance* heat at *HVAC zones* of new multiple-zone *HVAC systems* in Climate Zones 0 through 3 where the primary airflow rate in heating does not exceed the rate required to meet the Simplified Procedure ventilation requirements of ASHRAE Standard 62.1 for the zone based on the *design minimum outdoor air rate*.
11. *New electric resistance* heat as a replacement of existing *electric resistance* heat at *HVAC zones* in *alterations* of multiple-zone *HVAC systems* where the primary airflow rate in heating does not exceed the rate required to meet the Simplified Procedure ventilation requirements of ASHRAE Standard 62.1 for the zone based on the *design minimum outdoor air rate*.
12. *Electric resistance* heat at *HVAC zones* of new multiple-zone *HVAC systems* in Climate Zones 0 through 3 to meet the ventilation requirements of ANSI/ASHRAE/ASHE Standard 170 or other codes or accreditation standards approved by the *AHJ*.
13. *New electric resistance* heat as a replacement of existing *electric resistance* heat at *HVAC zones* in *alterations* of multiple-zone *HVAC systems* to meet the ventilation requirements of ANSI/ASHRAE/ASHE Standard 170 or other codes or accreditation standards approved by the *AHJ*.
14. Heat that is used only for pre-occupancy *building warm-up,* installed in series with the cooling coil and controlled to prevent operation when outside air is provided to the *space*.

Add the following to Section 13:

Reference		Section
American National Standards Institute (ANSI)		
CSA/ANSI Z21.40.4-23/CSA 2.94-2023	Performance testing and rating of gas-fired air conditioning and heat pump appliances	6.5.12.2.2