

**ANSI/ASHRAE/ICC/USGBC/IES Addendum bm to
ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1-2017**

Standard for the Design of High-Performance Green Buildings

Except Low-Rise Residential Buildings

The Complete Technical Content of the International Green Construction Code[®]

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ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

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FOREWORD

Addendum bm adds the option under the energy performance path in Standard 189.1 of modeling district energy systems that are not wholly contained within the project site boundary.

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

Addendum bm to Standard 189.1-2017

Modify Section 3 as shown.

3.2 Definitions

combined heat and power system (CHP): an on-site or off-site district energy conversion plant that delivers both electricity and thermal energy, where a portion or all of the thermal energy serves the *building project*.

district energy plant: a centralized cooling or heating plant (e.g., centralized chiller or boiler plant) that distributes *district heating or cooling* to multiple buildings and loads, one of which being the *building project*.

district energy system (DES): a thermal energy system made up of one or more *district energy plants* and a *district thermal distribution system*.

district heating or cooling: heat transfer media, such as chilled water, hot water, or steam, produced by a *district energy plant* and transported via a *district thermal distribution system*.

district thermal distribution system: a system for transporting *district heating or cooling* from a *district energy plant* to the *building project*. The system includes all energy consuming equipment involved with transport, including pumps, heat exchangers, water treatment, thermal losses, and pressure control.

Modify Section 7.5 as shown.

7.5 Performance Option

7.5.1 Annual Energy Cost. The *proposed building performance* cost index with consideration of renewables shall be calculated in accordance with ANSI/ASHRAE/IES Standard 90.1, Normative Appendix G, and be equal to or less than the Performance Cost Index (PCI) Target, as determined from the following equation:

$$PCI_{target} PCI_t = \frac{BBUEC + (BBREC \times BPF) - REC}{BBUEC + BBREC}$$

where

$PCI_{target} PCI_t$ = target PCI required for achieving compliance with the standard, unitless.

BBUEC = the component of *baseline building performance* that is due to *unregulated energy use*, \$

BBREC = the component of *baseline building performance* that is due to *regulated energy use*, or *baseline building performance* minus BBUEC, \$

BPF = building performance factor taken from Table 7.5.2A, unitless

REC = renewable energy production determined from Section 7.4.1.1.1 and converted to cost, \$

The proposed building PCI, without consideration of renewables, shall comply with the requirements of ANSI/ASHRAE/IES Standard 90.1, Section 4.2.1.1.

[. . .]

On-site renewable energy systems in the *proposed design* shall be calculated using the procedures in Normative Appendix C. For mixed-use buildings, the building performance factor (BPF) shall be determined by weighting each building type by floor area. A building project served in whole or in part by a district energy plant shall follow the modeling requirements contained in Normative Appendix C, Section C1.3, in order to comply with this section.

7.5.2 Annual Carbon Dioxide Equivalent (CO₂e). The *proposed design* shall have an annual CO₂e equal to or less than the annual CO₂e of the *baseline building design* multiplied by the building performance factor (BPF) target determined from Table 7.5.2A using the Performance Rating Method in ANSI/ASHRAE/IES Standard 90.1, Normative Appendix G. To determine the annual CO₂e for each energy source in the *baseline building design* and *proposed design*, the energy consumption shall be multiplied by the CO₂e emission factors from Table 7.5.2B. A building project served in whole or in part by a district energy plant shall follow the modeling requirements contained in Normative Appendix C, Section C1.3, in order to comply with this section.

Modify Normative Appendix C as shown.

NORMATIVE APPENDIX C PERFORMANCE OPTION FOR ENERGY EFFICIENCY

[. . .]

C1.3 Modeling of District Energy Systems. A building project served in whole or in part by a district energy plant shall comply with either Section C1.3.1 or C1.3.2.

C1.3.1 Modeling Purchased District Heating or Cooling. The proposed building performance and baseline building performance shall be calculated using the cost of purchased district heating or cooling for compliance with Section 7.5.1 as defined in Standard 90.1, Sections G3.1.1.1, G3.1.1.2, and

G3.1.1.3. *CO₂e* emission factors in Table 7.5.2B for *district heating or cooling* shall be used for compliance with Section 7.5.2.

C1.3.2 Performance Modeling of District Energy Systems. Two model simulation runs shall be completed for both the *proposed building performance* and *baseline building performance* in accordance with Sections C1.3.2(a) and C1.3.2(b).

- a. *The proposed building performance and baseline building performance* shall be calculated using the cost of purchased *district heating or cooling* as defined in Standard 90.1, Sections G3.1.1.1, G3.1.1.2, and G3.1.1.3. The *proposed building* shall comply with Standard 90.1 using the Performance Rating Method.
- b. Model the *district heating or cooling* in the building project using Standard 90.1, Normative Appendix G, with the following additions and alterations. All demands on the *district energy system* from the *building project* shall be modeled using time steps no longer than one hour. Documentation of *district energy systems* in the *proposed building performance* model shall be provided in accordance

with the requirements defined in Standard 90.1, Section G2.5, "Exceptional Calculation Methods." Projects shall comply with either Section C1.3.2(b)(1) or C1.3.2(b)(2).

1. **District Energy System Monitoring Path.** Data from energy metering equipment on an existing *district energy plant* shall be used to derive energy performance. All input energy used to operate the *district energy plant*, and all output *district heating or cooling* delivered by the *district thermal distribution system*, shall be metered. All *district energy plant* monitoring equipment shall be in place for at least one full 12 month period. Metered energy performance figures shall be used for the *proposed building performance* model and shall be derived at a level of detail no longer than one month. The *baseline building performance* model shall be completed in accordance with the requirements outlined in Table C1.2.
2. **District Energy System Modeling Path.** Complete the requirements of the *proposed and baseline building performance* models defined in Table C1.2.

Table C1.2 Performance Modeling of District Energy System Requirements

Proposed Building Performance	Baseline Building Performance
<p>1. District Cooling</p> <p>Model all cooling systems at the <i>district energy plant</i>, including energy conversion equipment and associated controls. Include all energy-using equipment, whether new or existing, that will impact the delivery of <i>district cooling</i> to the <i>building project</i>. Required systems include but are not limited to the following:</p> <ul style="list-style-type: none"> • Chillers • Make-up water pumping • Primary pumping • Heat-rejection loop pumping • Heat-rejection fans • Water treatment and pressurization systems • Heat exchanger losses 	<p>Model on-site cooling plant or packaged cooling as defined in Standard 90.1, Normative Appendix G, Tables G3.1.1-3 and G3.1.1-4, using energy performance values from Standard 90.1, Normative Appendix G.</p>
<p>2. District Heating</p> <p>Model all heating systems at the <i>district energy plant</i>, including energy conversion equipment and associated controls. Include all energy-using equipment, whether new or existing, that will impact the delivery of <i>district heating</i> to the <i>building project</i>. Required systems include but are not limited to the following:</p> <ul style="list-style-type: none"> • Boilers • Make-up water pumping • Primary pumping • Water treatment and pressurization equipment • Heat exchanger losses 	<p>Model on-site heating plant or packaged heating as defined in Standard 90.1, Normative Appendix G, Tables G3.1.1-3 and G3.1.1-4, using energy performance values from Standard 90.1, Normative Appendix G.</p>
<p>3. District Thermal Distribution System</p> <p>Model all equipment involved with the <i>district thermal distribution system</i>. Required systems include but are not limited to the following:</p> <ul style="list-style-type: none"> • Distribution and tertiary pumping • Heat exchanger and thermal distribution losses • Thermal distribution losses from leakage or nonreturn of distribution medium 	<p>Model thermal distribution systems in accordance with Standard 90.1, Normative Appendix G.</p>

Table C1.2 Performance Modeling of District Energy System Requirements (Continued)

Proposed Building Performance	Baseline Building Performance
<p>4. Combined Heat and Power Systems</p> <p><u>Model combined heat and power systems using the following methodology.</u></p> <p><u>Allocate electricity to the building project as a fraction of the total electricity output of the district energy system, where the fraction is the thermal energy provided to the building project divided by the total thermal energy output of the district energy system.</u></p> <p><u>Use Equation C-1 to determine the amount of electricity generated from the CHP system to be applied to the building project.</u></p> <p><u>Alternatively, use Equation C-2 if the CHP system includes cooling generation from recovered heat or if there is an additional waste heat recovery stream Z_{OTHER} (e.g., a CHP system could extract steam and hot water on two separate loops).</u></p> $CHP_ELEC_{BLDG} = (X_{HEAT} \times BLDG_{HEAT}) \times CHP_ELEC_{TOTAL} \quad (C-1)$ $CHP_{ELEC-BLDG} = [(X_{HEAT} \times BLDG_{HEAT}) + (Y_{CHW} \times BLDG_{CHW}) + (Z_{OTHER} \times BLDG_{OTHER})] \times \frac{CHP_ELEC_{TOTAL}}{CHP_ELEC_{TOTAL}} \quad (C-2)$ <p>where</p> <p>CHP_ELEC_{BLDG} = <u>CHP electricity generation allocated to the building</u></p> <p>X_{HEAT} = <u>fraction of the CHP plant's total production of waste heat applied to the DES</u></p> <p>$BLDG_{HEAT}$ = <u>fraction of total district heat provided to the building</u></p> <p>CHP_ELEC_{TOTAL} = <u>total CHP electricity generated at the DES plant</u></p> <p>Y_{CHW} = <u>fraction of the CHP system's total production of waste heat applied to producing chilled water in the DES</u></p> <p>$BLDG_{CHW}$ = <u>fraction of total district chilled water provided to the building</u></p> <p>Z_{OTHER} = <u>fraction of the CHP system's total production of waste heat applied to an additional form of district energy</u></p> <p>$BLDG_{OTHER}$ = <u>fraction of an additional form of district energy that is provided to the building</u></p>	<p>Do not model CHP.</p>
<p>5. Utility Tariffs</p> <p><u>Utility tariffs shall reflect the rates used on the building project determined in accordance with Standard 90.1, Section G2.4.2.</u></p>	<p>Same as <i>proposed design</i>.</p>
<p>6. Carbon Dioxide Equivalent Emissions Factors</p> <p><u>Carbon dioxide equivalent emission factors shall be applied to the energy supplied to the district energy system and reflect the values used in Table 7.5.2B, and shall be applied uniformly for all building project and district energy systems.</u></p>	<p>Same as <i>proposed design</i>.</p>

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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.

