

STANDARD

ANSI/ASHRAE/IES Standard 100-2018
(Supersedes ANSI/ASHRAE/IES Standard 100-2015)
Includes ANSI/ASHRAE/IES addenda listed in Annex N

Energy Efficiency in Existing Buildings

See Annex N for approval dates.

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This edition of Standard 100 is dedicated to the memory of Michele Friedrich for her devotion and commitment of many years to ASHRAE and to this standard, and to Jeff Park for his steadfast contribution to the previous edition of this standard.

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NOTE

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FOREWORD

Foreword not adopted.

Foreword to Washington State Amendments to ASHRAE Standard 100.

Standard 100 (##WAC) is adopted by the Washington state department of commerce pursuant to RCW 19.27A.200, 19.27A.210, and 19.27A.220. This standard has been adopted by reference and modified to implement the requirements for covered commercial buildings as directed by the Washington state legislature. The legislature delegated the responsibility of adoption and amendment of this standard to the Washington state department of commerce.

The Washington state administrative requirements for this standard are included in Normative Annex Z. For building owners that must comply with this standard, reading Normative Annex Z first allows the owner to put the rest of the standard in context. Multiple compliance options are available and should be reviewed prior to beginning implementation of this standard.

1. PURPOSE

1.1 This standard provides criteria that will result in reduced energy consumption through improved energy efficiency and performance in existing *buildings*. In adopting this standard by rule, Washington state department of commerce shall seek to maximize reductions of greenhouse gas emissions from the building sector.

1.2 This standard is directed toward providing procedures and programs essential to energy efficient operation, maintenance, management, and monitoring; increasing the energy efficiency of the energy-using systems and components; and upgrading the thermal performance of the *building* envelope.

2. SCOPE

This standard is mandatory for all covered commercial buildings located in the state of Washington. This standard is also applied as a voluntary standard for applicable multifamily residential buildings seeking early adopter incentives consistent with RCW 19.27A.220.

This standard applies to existing *buildings*, portions of *buildings*, and *building* complexes, including the envelope and all systems in the *building*. This standard excludes industrial and agricultural processes in *buildings* for which the *energy targets* do not include those processes.

3. DEFINITIONS

3.1 General. Certain terms, abbreviations, and acronyms are defined in this section for the purposes of this standard. These definitions are applicable to all sections of this standard.

Terms that are not defined herein, but that are defined in standards that are referenced herein, shall have the meanings as defined in those standards.

Other terms that are not defined shall have their ordinarily accepted meanings within the context in which they are used. Ordinarily accepted meanings shall be based on American Standard English language use, as documented in an unabridged dictionary accepted by the *authority having jurisdiction*.

agricultural structure: A structure designed and constructed to house farm implements, hay, grain, poultry, livestock, or other horticultural products, and is not a place used by the public or a place of human habitation or employment where agricultural products are processed, treated, or packaged.

analog control: a control loop in which data is expressed or measured by means of one or more physical properties that can express any value along a continuous scale. All types of control systems may provide *analog control*.

applicable building codes: The Washington state building codes as adopted by the Washington state building code council, and as modified by local government amendments.

authority having jurisdiction (AHJ): Washington state department of commerce.

baseline: the first-year *energy-use intensity* for the *building* at the beginning of the compliance determination process.

baseline energy use intensity: A building's weather normalized energy use intensity measured for twelve consecutive months within two years prior to making an application for an incentive under RCW 19.27A.220

binary control: a control loop in which there are only two states, such as on-off or open-closed.

building: a structure, including mobile homes, manufactured homes, and other factory-built *buildings*, wholly or partially enclosed within exterior walls, or within exterior and party walls, and a roof, that affords shelter to persons, animals, or property.

building manager: the person responsible for maintaining the *building*, its envelope, and its energy-using systems. The *building manager* may also be the person responsible for expending funds on capital improvements to the *building*.

building operator: the person or persons who have responsibility to inspect, operate, and *maintain* the *building* systems and components that fall within the scope of this standard. The *building operator* may be an employee of the *building owner*, the *building manager*, or a contractor.

building owner: an individual or entity possessing title to a *building*.

campus: A campus is a collection of buildings served by a campus district heating, cooling, water reuse and/or power system owned by the same building owner.

campus district heating and/or cooling system: district heating and/or cooling system that serves a campus and is owned by the building owner.

capital management plan: a financial plan to set aside capital to replace or upgrade *building* systems at the end of their useful life and/or to improve performance and energy efficiency.

certified commissioning professional: A person who is certified by an ANSI/ISO/IEC 17024:2012 accredited organization to lead, plan, coordinate, and manage commissioning teams and implement the commissioning process and with experience commissioning at least two projects of similar size and of similar equipment to the current project, and at least one in the last three years. This experience includes the writing and execution of verification checks and functional test plans.

complex: A group of buildings interconnected by conditioned spaces on contiguous property.

conditional compliance: A temporary compliance method used by building owners that demonstrates the owner has implemented energy use reduction strategies required by the standard, but has not demonstrated full compliance with the energy use intensity target.

conditioned space: An area, room or space that is enclosed within the building's thermal envelope and is directly heated or cooled or is indirectly heated or cooled. Spaces are indirectly heated or cooled where they communicate through openings with conditioned spaces, where they are separated from conditioned spaces by uninsulated walls, floors or ceilings, or where they contain uninsulated ducts, piping or other sources of heating or cooling. (also see, semi-heated space).

covered commercial building: A building where the sum of nonresidential, hotel, motel, and dormitory floor areas exceeds fifty thousand gross square feet, excluding the parking garage area.

crawl spaces: a shallow, unfinished space beneath the first floor or under the roof of a *building*.

daylight harvesting: the automatic control of electric light levels in response to the amount of daylight in the space.

daylight hours: the period from 30 minutes after sunrise to 30 minutes before sunset.

dimmer: a device that varies the current through an electric light in order to control its level of illumination and energy usage.

direct digital control (DDC): a control system consisting of microprocessor-based controllers that monitor and control *building* systems equipment through input devices (such as sensors), output devices (such as switches and actuators), and programmed control sequences.

discounted payback: The time when the accumulated savings achieved by an investment, discounted by the appropriate discount rate, equals the initial cost of the investment.

district heating and/or cooling system: Is a system that provides heating or cooling to multiple buildings through a distributed system providing steam, hot water or cool water to buildings.

energy accounting system: a system for measuring, collecting, and documenting the *building's* use of energy.

energy auditor: see *qualified energy auditor*.

energy cost: the total cost for energy supplied to a *building* or *building* site, including such charges as base charges, consumption charges, demand charges, customer charges, power factor charges, and miscellaneous charges such as sales taxes.

energy efficiency measure (EEM): an action taken in the operation or equipment in a *building* that reduces the energy use of the *building* without negative impact within the *building*.

energy manager (EM): the individual, identified by the *building owner*, who has responsibility for ensuring that energy use in the *building* is minimized without compromising the indoor environmental quality (*building* indoor air quality, thermal comfort, visual acuity and comfort, sound quality). The *EM* may be the *building owner*, a tenant, an employee of the owner or tenant, or a contractor retained by the owner or tenant.

energy-use intensity (EUI): a measurement that normalizes a building's site energy use relative to its size. A building's energy use intensity is calculated by dividing the total net energy consumed in one year by the gross floor area of the building, excluding the parking garage. "Energy use intensity" is reported as a value of a thousand British thermal units per square foot per year.

Energy target (EUI_t): Not adopted.

energy use intensity target (EUI_t): the net energy use intensity of a covered commercial building that has been established for the purposes of complying with the standard.

gross floor area: the total number of square feet measured between the exterior surfaces of the enclosing fixed walls of a building, including all supporting functions such as offices, lobbies, restrooms, equipment, storage areas, mechanical rooms, break rooms, crawl spaces and elevator shafts. Gross floor area does not include outside bays or docks.

gross floor area for residential buildings: Not adopted.

gross floor area for nonresidential buildings: Not adopted.

high-efficacy lamps: lamps with a minimum efficacy of 60 lm/W for lamps over 40 W, 50 lm/W for lamps over 15 to 40 W, or 40 lm/W for lamps 15 W or less.

HVAC system: the equipment, distribution systems, and terminals that provide the processes of heating, ventilating, or air conditioning to a building or portion of a building.

industrial process: a systematic series of mechanical or chemical operations that produce or manufacture something.

interactive effect: the change in resultant energy-savings estimates or actual energy savings due to analyzing or implementing multiple EEMs that interact with one another.

internal rate of return (IRR): the discount rate in a capital project that makes the net present value of all cash flows from a particular project equal to zero. The higher a project's IRR, the more desirable it is to undertake the project. IRR can be used to rank several prospective projects under consideration. IRR is defined by the following equation:

$$0 = \sum_{t=1}^n \frac{CF_t}{(1 + IRR)^t} - CF_0$$

where

n = the useful life of the measure in years

CF_t = the annual cost savings of the measure in year t
(cash flow in year t)

CF_0 = the initial cost of the measure (cash flow initial)

lamp: a replaceable component of a luminaire, such as an incandescent light bulb, which is designed to produce light from electricity.

lighting schedule: a list that provides a count of all luminaires in the building, their lamps, lighting controls, fixture types, and product information.

lighting power density: the lighting power per unit area of a building or a space in a building.

luminaire: a complete lighting unit consisting of a lamp or lamps (and ballasts and/or drivers when applicable) together with the housing designed to distribute the light, position and protect the lamps, and connect the lamps to the power supply.

maintain: the process of keeping equipment and components operating or functioning in accordance with manufacturers' recommendations and industry standards over their service lives. It involves but is not limited to carrying out observation, lubrication, adjustment, calibration, testing, cleaning, replacement, and repair at appropriate intervals as applicable to the specific equipment or component.

more recently built buildings: buildings or additions greater than 50,000 square feet in conditioned floor area permitted for construction based on the application permit date of July 1, 2016, or later. For example, buildings permitted to the 2015 edition of the Washington State Building Code, chapter 51-50 WAC.

motion sensor: an occupancy sensor used for exterior areas.

multiscene control: a lighting control device or system that allows for two or more predefined lighting settings, in addition to an "all off" setting, for two or more groups of luminaires to suit multiple activities in the space, and allows the automatic recall of these settings.

net energy: the sum of the metered energy entering the building minus metered energy leaving the building. The same applies to portions of buildings with submetering. Bulk fuels are included using the equation in Section 5.2.2.1.

nighttime hours: the period from 30 minutes before sunset to 30 minutes after sunrise.

nonrenewable energy: energy other than renewable energy or recovered energy.

nonresidential building: as used in this standard, any *building* that does not match one of the types of residential *buildings* listed in the Table 7-1.

nontarget buildings: *buildings* with activities not listed in Table 7-1 in more than 50% of the gross floor area.

occupancy sensor: a device that detects the presence or absence of people within an area and causes lighting, equipment, or appliances to be regulated accordingly.

optimized bundle: a collection of *EEMs* that maximizes the energy savings at a facility within the cost effectiveness criteria of the standard. It excludes any measure with a *simple payback* that exceeds the life of the measure. A bundle of measures is optimized by including the maximum number of *EEMs* within the bundle while still meeting the cost effectiveness criteria. The process for determining the *optimized bundle* may be an iterative one due to *interactive effects* of individual *EEMs*.

photosensor: a device that detects the presence of and/or measures the amount of visible light, infrared (IR) transmission, and/or ultraviolet (UV) energy, and emits a signal based on the presence, absence, and/or amount of these entities.

primary energy: see *source energy*.

qualified energy auditor: A person acting as the auditor of record having training, expertise and three years professional experience in building energy auditing and any one of the following:

- a. A licensed professional architect or engineer.
- b. An *energy auditor/assessor/analyst* certified by ASHRAE or the Association of Energy Engineers (AEE) for all *building* types.

qualified commissioning authority: Not adopted.

qualified person: A person having training, expertise and three years professional experience in building energy-use analysis and any of the following:

- a. A licensed professional architect or engineer in the jurisdiction where the project is located
- b. A person with Building Operator Certification (BOC) Level II by the Northwest Energy Efficiency Council.
- c. A certified commissioning professional
- d. A qualified energy auditor;
- e. A certified energy manager (CEM) in current standing, certified by the Association of Energy Engineers (AEE).

recommissioning: an application of the commission process requirements to a project that has been delivered using the Commissioning Process.

residential building: not adopted.

recovered energy: energy reclaimed for useful purposes that would otherwise be wasted.

savings-to-investment ratio: the ratio of the total present value savings to the total present value costs of a bundle of an energy or water conservation measure estimated over the projected useful life of each measure. The numerator of the

ratio is the present value of net savings in energy or water and nonfuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure.

semi-heated space: an enclosed space within a building, including adjacent connected spaces separated by an uninsulated component (e.g., basements, utility rooms, garages, corridors), which:

1. Is heated but not cooled, and has a maximum installed heating system output capacity of 3.4 Btu/(h-ft²) but not greater than 8 Btu/(h-ft²);
2. Is not a walk-in or warehouse cooler or freezer space.

service life. See *useful life*.

service log: a document in which service and maintenance work performed for a given piece of equipment is recorded, and that contains a date, the service technician's name, and a description of work performed.

simple payback (years): the estimated initial cost of an *EEM* divided by the estimated annual cost savings of the measure expressed in years. The cost savings may include *energy cost* savings and incremental routine operations and maintenance costs.

site energy: energy consumed by a *building* as measured at the boundaries of the *building* site.

source energy: energy consumed by a *building* as measured at the *building* converted using source (primary) energy conversion factors to account for the energy consumed in the extraction, processing, and transport of primary fuels such as coal, oil, and natural gas; energy losses in thermal combustion in power-generation plants; and energy losses in transmission and distribution to the *building*. See also *primary energy*.

state equipment standards: appliance and equipment standards listed in chapter 19.260 RCW, Energy efficiency.

useful life: useful life is the expected remaining service life of building systems or equipment. Used interchangeably with Service Life.

weather normalized: A method for modifying the measured building energy use in a specific weather year to energy use under normal weather conditions.

weather normalized energy utilization index (WNEUI): a measurement that normalizes a building's site energy use relative to its size based on the buildings weather normalized site energy use. A building's energy use intensity is calculated by dividing the total net weather normalized energy consumed in one year by the gross floor area of the building, excluding the parking garage. Weather normalized energy use intensity is reported as a value of a thousand British thermal units per square foot per year.

zone: a space or group of spaces within a *building* for which the heating, cooling, or lighting requirements are sufficiently similar that desired conditions can be maintained throughout by a single controlling device.

3.2 Common abbreviations and Acronyms

<i>AEE</i>	<i>Association of Energy Engineers</i>
<i>AHJ</i>	<i>authority having jurisdiction</i>
<i>DDC</i>	<i>direct digital control</i>
<i>EEM</i>	<i>energy efficiency measure</i>
<i>EM</i>	<i>energy manager</i>
<i>EUI</i>	<i>energy-use intensity</i>
<i>IRR</i>	<i>internal rate of return</i>
<i>O&M</i>	<i>operations and maintenance</i>
<i>WNEUI</i>	<i>weather normalized energy utilization index</i>

4. COMPLIANCE REQUIREMENTS

4.1 Building Type Requirements

4.1.1 Nonresidential Building

4.1.1.1 A *building* or *complex of buildings* whose majority of gross floor area has activities number in Table 7-1 shall comply with the requirements of Sections 4.2 and 4.3.

4.1.1.2 The *qualified person* determining compliance shall

1. Determine whether or not the *building* seeking compliance has an *energy target (EUI_t)* according to Section 7,

2. Establish the *energy target (EUI_t)* according to Section 7,

3. Submit forms as specified in Normative Annex Z to the AHJ.

4.1.2 Residential Building - Not adopted.

4.1.3 Buildings with residential and nonresidential activities - Not adopted

4.2 Energy Management Plan and Operations and Maintenance Program

4.2.1 Operations and Maintenance. The *building manager* shall comply with the operations and maintenance (O&M) requirements of Section 6. The *qualified person* determining compliance shall state in writing on Form A that the operating and maintenance requirements of Section 6 have been met according to the following subsections.

4.2.1.1 For first-time applicants, for the previous year.

4.2.1.2 For previously compliant *buildings*, since the previous validation of compliance.

4.2.2 Energy Management Plan. The *building manager* shall comply with the energy management requirements of Section 5. The *qualified person* determining compliance shall state in writing on Form A that the energy management program described in Section 5 has been developed and is being maintained as of the date on Form A.

4.3 Building Energy Use

4.3.1 Measured EUI. The *qualified person* shall calculate the *building's* measured *energy-use intensity (EUI)* by completing Form C according to Section 5.2.

4.3.2 Buildings with Energy Targets. Buildings with energy targets must meet all the criteria for developing an energy target in Section 7.2 Determining energy use intensity target (EUI_t) and provide energy use data as specified by Section 5.2 Building energy monitoring. All other buildings shall comply with Section 4.3.3, Buildings without energy targets.

4.3.2.1 Building Meets the Energy Target (EUI_t). If the *building's* measured *EUI* is less than or equal to its *energy target*, the *building* complies.

4.3.2.2 Building Does not Meet the Energy Target (EUI_t). A qualified energy auditor shall complete an energy audit according to Section 8, and EEMs that will reduce energy use to meet the energy target shall be implemented according to Section 9. Upon completion of the implementation of all required EEMs, a building shall be granted conditional compliance.

Exception to 4.3.2.2:

1. *More recently built buildings:* For buildings that exceed the target developed in accordance with Section 7.2.1.1, but do not exceed the target developed in accordance with Section 7.2.1, the owner may demonstrate compliance by recommissioning the building using the existing-building commissioning process as described in ASHRAE Guideline 0.2-2015 Commissioning Process for Existing Systems and Assemblies and ASHRAE Guideline 1.2-2018 Technical Requirements for the Commissioning Process for Existing HVAC&R Systems and Assemblies. The commissioning process and the following:

- a. A certified commissioning professional shall implement the building commissioning process specified by the most recent edition of the Washington state energy code. The energy code commissioning process shall be modified by the

certified commissioning professional for recommissioning purposes.

- b. Washington state energy code (WSEC) exceptions based on mechanical system or service water heating capacity shall not be applied when developing the scope for commissioning. For example, the 2018 WSEC, Section C408.1 General, exceptions 1 and 2 or the exception to Section C408.2.
- c. All deficiencies found during the commissioning process shall be resolved including corrections and retesting.
- d. Building owners may omit capital expenditures identified by the commissioning process that are not cost effective, as documented using the procedures in Normative Annex X.

2. No individual requirement need be met that would compromise the historical integrity of a building or part of a building designated by a government body for long-term preservation in its existing state, such as historical monuments. Documentation of historic significance must be provided to the AHJ by submitting Form G in accordance with Normative Annex Z.

4.3.2.3 Verification of Compliance. Within fifteen months after the completion of Section 4.3.2.2, the weather normalized EUI shall be recalculated by the energy manager (EM) from twelve consecutive months of measured energy use, and Form A shall be resubmitted to the AHJ. If the building's post implementation measured EUI is less than or equal to the energy target, the building complies with the standard. If the building's post implementation measured EUI is greater than the energy target, the building does not comply with the standard and the conditional compliance is suspended until either

- a. additional EEMs have been implemented that reduce the subsequently measured EUI to below the energy target and a new Form A is submitted to the AHJ or
- b. the AHJ revokes conditional compliance.

4.3.3 Buildings without Energy Targets

4.3.3.1 A *qualified energy auditor* shall conduct an energy audit according to Section 8, and the *optimized bundle* of *EEMs* shall be identified according to Section 9.1.1.2.

4.3.3.2 Implement EEMs. The entire *optimized bundle* of *EEMs* identified shall be implemented. Upon completion of the implementation of the *optimized bundle* of *EEMs*, a *building* shall be granted *conditional compliance* in accordance with Section 9.1.1.2.

Exception to 4.3.3.2: No individual requirement need be met that would compromise the historical integrity of a building or part of a building designated by a government body for long-term preservation in its existing state, such as historical monuments. Documentation of historic significance must be provide to the AHJ by submitting Form G in accordance with Normative Annex Z.

4.3.3.3 Verification of Compliance. If the *building* complies with Section 4.2, then within 15 months following the completion of implementation of the *optimized bundle* of *EEMs*, *building owners* with *conditional compliance* or the *qualified person* representing the *building owner* shall submit verification that measured postimplementation energy savings meet or exceed 75% of the energy savings projected in the energy audit report to the *AHJ*. Energy savings shall be compared at the whole-*building* consumption level in common units for electricity, fossil fuels, and other sources. If the measured postimplementation energy savings of the package of *EEMs* do not meet or exceed 75% of the energy savings projected in the energy audit, the *conditional compliance* is suspended until either

- a. additional *EEMs* are implemented that reduce the subsequently measured energy savings of the package of *EEMs* so that it meets or exceeds 75% of the energy savings projected in the energy audit or
- b. the *AHJ* revokes *conditional compliance*.

4.4 General

4.4.1 Administrative Requirements. Building owners shall demonstrate compliance with the standard by following the administrative requirements in Normative Annex Z, including:

Normative Annex Z, Washington state reporting requirements.

Building owner notifications by the AHJ and building owner response.

Z1 Notification to building owners of covered commercial buildings by the AHJ

Z2 Building owner response to notifications

Washington state reporting requirements for building owners.

Z3 General Compliance

Z4 Documentation of compliance with the standard

Z5 Violations, assessment of administrative penalties, mitigation and review of penalty decisions

Z6 Compliance Forms

Z7 Section 7 tables as modified by Washington state.

4.4.2 Alternative energy targets (EUI_t) - Not adopted

5. ENERGY MANAGEMENT PLAN

5.1 Establish the Energy Management Plan

5.1.1 The *building owner* shall designate an *energy manager (EM)* to develop and *maintain* an energy management plan for the *building*.

Exception to 5.1.1 - Not adopted.

5.1.2 The energy management plan shall incorporate the following.

5.1.2.1 Energy accounting in accordance with Section 5.2.

5.1.2.2 In the initial year of compliance, the building's weather normalized energy use intensity (WNEUI) and energy-use intensity (EUI).

5.1.2.3 Annual updates of the net energy use, WNEUI and EUI.

5.1.2.4 Annual comparison of the net WNEUI and EUI to the energy target.

5.1.2.5 Documentation of original, current, and changes in number of occupants, weekly operating hours, or time of day scheduled for occupancy, production rates, and energy using equipment that would have caused change in the measured WNEUI and EUI.

5.1.2.6 Energy audit reports and recommended *energy efficiency measures (EEMs)*. (Refer to Section 8.)

5.1.2.7 A list of *EEMs* that have been implemented and dates of implementation, including the following:

- a. An operations and maintenance (O&M) program as defined in Section 6 for the *EEMs*
- b. An implementation plan for *EEMs*, including *EEM* commissioning
- c. Staff training plan for *EEMs*
- d. Ongoing commissioning plans for the *EEMs*

5.1.2.8 A method to inform occupants about the benefits of efficient energy use, and to instruct them in the use and adjustment of operable windows, *HVAC system* controls, and lighting system components and controls. This shall include materials (electronic or printed) as appropriate.

5.1.2.9 A training plan for the O&M personnel to operate the *building* systems to achieve established indoor environmental targets with optimum energy efficiency.

5.1.2.10 A *capital management plan* identifying equipment for replacement with energy efficient and ENERGY STAR® rated equipment in case of failure.

5.1.2.11 A contact list of suppliers and manufacturers' local representatives of energy efficient equipment, *qualified energy auditors*, the *EM*, and the *building owner*.

5.1.2.12 The current *lighting schedule* and the calculated *lighting power density* along with the potential savings from any potential *EEMs*.

5.1.2.13 The current lighting satisfaction survey and lighting checklist as described in Appendix D of *Performance Measurement Protocols for Commercial Buildings* 1.

5.1.2.14 Operations and Maintenance Plan including:

1. An operations and maintenance (O&M) program as defined in Section 6.
2. An O&M implementation plan as specified in Normative Annex L.
3. Implementation documentation as specified in L2.2.5 Documentation.

5.1.3 The *EM* shall provide a copy of the energy management plan to the *building* occupants and other stakeholders annually.

5.1.4 The *building owner* shall review and sign the energy management plan annually.

5.2 Building Energy Monitoring. *Building net energy* use shall be monitored and recorded in accordance with following sections.

5.2.1 Provide measured net energy consumption data for each building, including all forms of imported and exported energy from at least twelve consecutive months of data monitored in a period not to exceed two years prior to the reporting deadline specified in Normative Annex Z. The net energy concept is illustrated in Figure 5-1 and Table 5-1 and is calculated in accordance with Section 5.2.4 as follows:

$$\begin{aligned} \text{Net energy use} &= (1a + 1b + 1c + 1d) \\ &\quad - (3a + 3b + 3c + 3d + 3e) \end{aligned}$$

where 1a, 1b, 1c, and 1d are metered energy supplies that are used in the *building* (this includes bulk energy sources), and 3a, 3b, 3c, 3d, and 3e are metered energy excesses that are supplied to another *building, vehicle or grid as useful energy*.

5.2.2 Energy-use data for each type of energy imported into and exported from the building shall be collected from utility or energy delivery bills (that must include the quantity of energy or fuel delivered) or by monitoring local energy meters (either utility or owner-provided meters). Owner provided energy meters shall meet the metering accuracy, tolerances and testing requirements of WAC 480.

5.2.2.1 When an energy type such as oil, solid fuels, or biomass is delivered in bulk to the *building* for storage prior to actual use, the annual energy use for that energy type shall be calculated as follows:

$$\text{Annual energy use} = A + B - C$$

where

- A = measured inventory of the energy type at the beginning of the 12 month period, converted to energy equivalent (Refer to Section 5.2.3.)
- B = the amount of the energy type delivered to the *building* during the 12month period, converted to energy equivalent (Refer to Section 5.2.3.)
- C = measured inventory of the energy type at the end of the 12 month period, converted to energy equivalent (Refer to Section 5.2.3.)

5.2.2.2 If the annual energy consumption of an inventoried energy type is less than twice its on-site storage capacity, the inventory measurement accuracy and methodology shall be reported as part of the *energy accounting system* documentation.

5.2.3 Energy Conversion Factors. The *site energy* content of different forms of purchased energy shall be converted from the purchased unit to the standard *site energy* unit using the conversation factors incorporated in Energy Star portfolio manager.

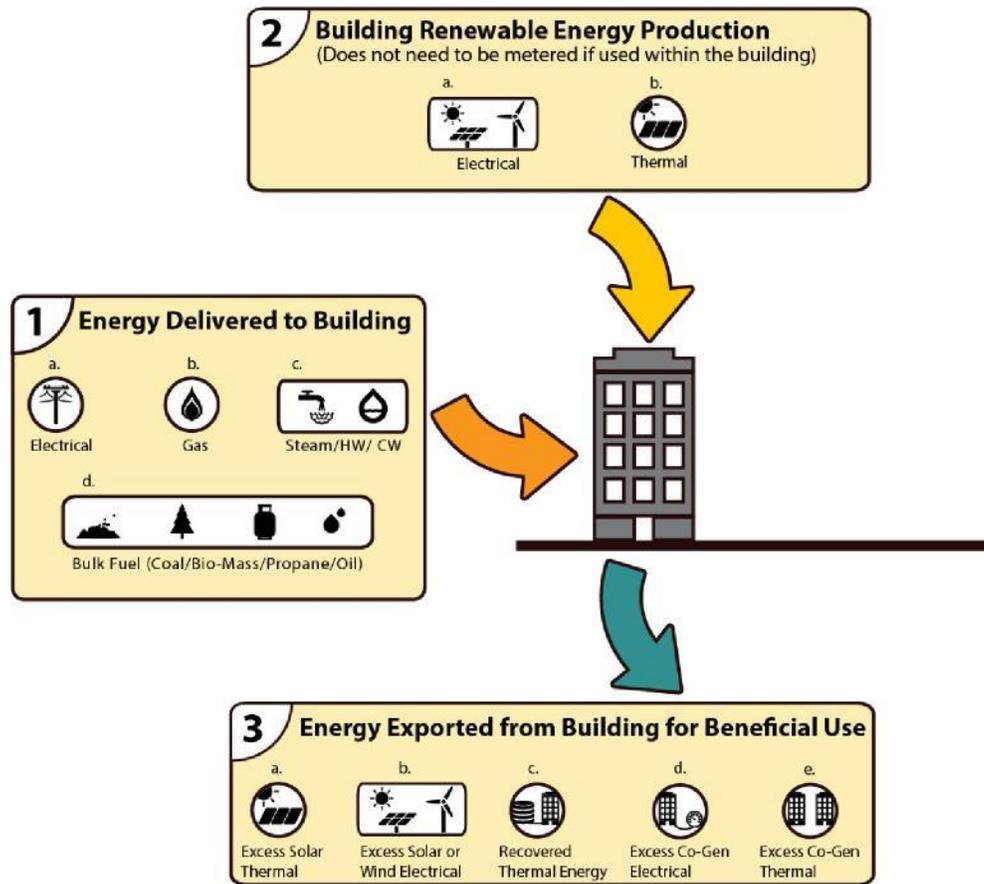


Figure 5-1 Net energy concept.

Table 5-1 Energy Flow Definitions

Energy Delivered to Building	Building Renewable Energy Production	Energy Exported from Building for Beneficial Use
1a. Electrical	2a. Electrical	3a. Excess solar thermal
1b. Gas	2b. Thermal	3b. Excess solar or wind electrical
1c. Steam/hot-water (HW)/chilled and hot water (CHW)		3c. Recovered thermal energy
1d. Bulk fuel (coal/biomass/propane/oil)		3d. Excess co-gen electrical
		3e. Excess co-gen thermal

5.2.4 The energy accounting system shall be Energy Star Portfolio Manager as specified in Normative Annex Z.

5.2.4.1 - Not adopted.

5.2.4.2 - Not adopted.

5.2.4.3 - Not adopted.

5.2.4.4 - Not adopted.

Table 5-2a Site Energy Conversion Factors - Table not adopted.

Table 5-2b Primary Energy Conversion Factors- Table not adopted.

5.2.4.4 Record each residential building's EUI as follows, as applicable:

- a. annual net energy use, MJ/gross floor area for residential buildings, m²
- b. annual net energy use, kBtu/gross floor area for residential buildings, ft²

5.3 Energy Manager. The EM shall be responsible for the following.

5.3.1 Conducting technical, policy-related planning related to energy efficiency.

5.3.2 Purchasing energy for spaces under his or her control.

5.3.3 Public relations matters related to energy.

5.3.4 Implementing the results of energy audits and EEMs outlined in the energy management plan.

5.3.5 Evaluating energy efficiency of proposed new construction, facility expansion, remodeling, or new equipment purchases.

5.3.6 Reviewing *building* O&M procedures for optimal energy management.

5.3.7 Adhering to energy codes and standards.

5.3.8 Reporting regularly to management and other stakeholders .

5.3.9 Developing and implementing an energy efficiency plan according to Section 9.1.

6. OPERATIONS AND MAINTENANCE REQUIREMENTS

6.1 Scope. Section 6 applies to the *building* envelope, *building* systems, and *building* equipment that directly or indirectly consume energy.

6.2 Operations and Maintenance Program. A formal operations and maintenance (O&M) program shall be established and implemented in order that the *building* energy-using systems achieve their intended energy efficiency throughout their service life.

It documents the O&M objectives, establishes the criteria for evaluation, and commits the *building operator* and maintenance personnel to basic goals of performance (such as minimizing equipment failures, ensuring ongoing efficient operation, and performing identified maintenance requirements).

6.3 Operation and Maintenance (O&M) Implementation. The O&M program shall be implemented in accordance with Normative Annex L.

Exception to 6.3: O&M programs developed and implemented by the building's serving utility or local government and approved as equivalent or more stringent by the AHJ may be used as an alternative to this requirement in Section 6.3. Where local government programs are more

stringent, local government programs shall be selected over utility programs.

6.4 Operations and Maintenance Tasks

6.4.1 Maintenance for all equipment, components, and systems shall be in accordance with applicable manufacturers' requirements and shall also include tasks that minimize failures and *maintain* energy consumption efficiency, such as those found in Informative Annex D for the following *building* systems:

- *Building* envelope
- Domestic hot water
- Heating, ventilation, and air conditioning
- Refrigeration
- Lighting
- Controls
- Electric power distribution and on-site power generation

6.4.2 Safe and reasonable access shall be provided to all equipment covered by the O&M program for inspection, maintenance, and repairs.

6.4.3 The O&M requirements shall be reevaluated when *building* use changes or renovations/alterations are made that affect the facility's operations.

6.5 Tenant Improvements. The *energy manager (EM)* shall put in place a formal process to ensure that any tenant improvements involving a change in space use or the relocation of partitions (including partial height partitions) do not change the annual *net energy* use except to the extent that the annual *net energy* use change (increase or decrease) is consistent with any change in the *building's energy target*.

6.6 Equipment and Component Replacement

6.6.1 When HVAC, domestic hot-water heating, or refrigeration equipment or appliances are replaced, the replacement equipment shall meet the most stringent energy efficiency requirements in the federal equipment standards, in the applicable *building* code.

Exception to 6.6.1: - Not adopted.

6.6.2 Lighting Replacement

6.6.2.1 When lighting equipment is replaced, the replacement equipment shall meet the most stringent energy efficiency requirements in the federal equipment standards, state equipment standards and in the applicable building code. Implementation of more efficient equipment shall be evaluated and included as specified for the capital management plan, section 5.1.2.10.

6.6.2.2 The replacement of any lighting equipment shall not increase the existing installed lighting power demand.

Exception to 6.6.2.2: The existing installed lighting power may proportionally increase when the current light levels are below those recommended in the IES *Lighting Handbook* 4.

7. ENERGY-USE ANALYSIS AND TARGET REQUIREMENTS

7.1 Building Type and Energy Targets

7.1.1 Building Type. *Buildings* are divided into types or activities as shown in Table 7-1, normative annex Z. Building type definitions are based on energy star portfolio manager, unless modified by the notes to table 7-1.

7.1.2 Energy Targets. Energy targets for each building type are listed in table 7.2a, normative annex Z.

7.1.3 Building Operating Shifts Normalization Factors - Building Operating Shifts Normalization Factors for each building type are listed in table 7-3, normative annex Z.

7.2 Determining Energy Target (EUI)

7.2.1 The qualified person shall determine the energy use intensity target (EUI_t) according to Section 7.2.2 for single-type/activity buildings and Section 7.2.3 for mixed-use buildings, and shall complete Form B.

Exception to 7.2.1: EUI_t programs developed and implemented by the building's local government and approved as equivalent or more stringent by the AHJ may be used as an alternate to this requirement.

7.2.1.1 Additional target for more recently built buildings: In addition to the requirements of section 7.2.1, more recently built buildings shall create a second EUI_t that is 15% less than the target developed for compliance with section 7.2.1. This shall be the building EUI_t and shall be included on Form B.

7.2.2 *Energy targets for buildings* with a single activity shall be calculated as follows:

$$(EUI_t) = S \times (EUI_{t1})$$

where (EUI_{t1}) is the building activity energy target value in Table 7-2a for the appropriate building activities/types and climate, and S is the building operating shifts normalization factor in Table 7-3.

7.2.3 *Energy targets for buildings* with multiple activities shall be determined using weighted averages of *building activity energy target* for each area with a single activity, per the following equation, and reported on Normative Annex C, Form B:

$$EUI_t = (A \times S \times EUI_{t1})_1 + (A \times S \times EUI_{t1})_2 + \dots + (A \times S \times EUI_{t1})_i + \dots + (A \times S \times EUI_{t1})_n$$

where

- (A)_i = percentage of the gross floor area with single building activity *i*
- (EUI_{t1})_i = building activity target from Table 7-2a or 7-2b for space *i*
- (S)_i = operating shifts normalization factor from Table 7-3 for space *i*
- (A × S × EUI_{t1})_i = the weighted space EUI target for space *i*

Exceptions to 7.2.3:

The energy use intensity target (EUI_t) of a building may be modified using the following exceptions. None of these exceptions may be used to change the total gross floor area as it applies to Normative Annex Z, Reporting schedule.

1. Spaces where more than 75% of the gross floor area has a single building activity listed in Table 7-1 shall be reported as a single-use building or as a multiuse building in accordance with either Section 7.2.2 or Section 7.2.3.
2. Spaces less than 10% of the gross floor area with building activity listed in Table 7-1 can combine their floor area with the floor area within the building that has a similar building activity and similar EUI_t as determined by the qualified person.
3. Spaces in buildings with multiple activities that are not listed in Table 7-1 and have a total combined area $\sum A_{\text{nontarget}}$ comprising less than 10% of the building gross floor area A_{gross} can be excluded from building energy target calculations if the energy use of such space is metered separately and the nontarget spaces comply with Sections 4.1 and 4.2. The energy target for the remaining part of the building shall be calculated after deducting the unlisted building type floor area from the building gross floor area ($A_{\text{gross}} - \sum A_{\text{nontarget}}$). Nontarget spaces shall be limited to the floor area occupied by the nontarget activity and shall not include supporting spaces such as corridors, common areas or other space types listed in Table 7-1.
4. Spaces in buildings with multiple activities that are not listed in Table 7-1 and have a total combined area $\sum A_{\text{nontarget}}$ comprising less than 50% of the building gross floor area A_{gross} can be excluded from building energy target calculations if the energy use of such space is metered separately and the nontarget spaces comply with Sections 4.1, 4.2, 4.3.1, and 4.3.3. The energy target for the remaining part of the building shall be calculated after deducting the unlisted building type floor area from the building gross floor area ($A_{\text{gross}} - \sum A_{\text{nontarget}}$). Nontarget spaces shall be limited

to the floor area occupied by the nontarget activity and shall not include supporting spaces such as corridors, common areas or other activity types listed in Table 7-1.

7.2.4 Energy Targets for Vacant and Partially Vacant Buildings

Exemption to Section 7.2.4 Vacant buildings. If the building did not have physical occupancy by owner or tenant for at least fifty percent of the conditioned floor area throughout the consecutive twelve month period prior to the building compliance date, the building owner may apply for an exemption as specified in Normative Annex Z.

7.2.4.1 The energy target for vacant spaces shall be based on its prevacancy activity if the intended use of the building will be unchanged.

7.2.4.2 If the total floor area of a nonheated, noncooled, and non illuminated vacant part of a building is smaller than 30% of the gross floor area, then it shall be excluded from the gross floor area, and the energy target shall be determined based on the remainder of the building as described in Section 7.2.3. This allowance may not be used to change the total gross floor area as it applies to Normative Annex Z 3.1, Reporting schedule.

7.2.4.3 If the vacant part of a building is heated and/or cooled and the building energy-use data for twelve consecutive month period when the building was occupied within two years prior to the compliance date is not available, compliance of this part of the building will be determined

after it becomes occupied and energy-use data become available for 12 consecutive months.

Table 7-1 Commercial and Residential Building Types/Activities

Table 7-1 adopted as modified and published in Section Z7

Table 7-2a Building Activity Site Energy Targets (EUIt1) (I-P Units)

Table 7-2a adopted as modified and published in Section Z7

Table 7-2a Building Activity Site Energy Targets (EUIt1) (SI Units) - Not adopted

Table 7-2b Building Activity Source Energy Targets (EUIt1) (I-P Units) - Not adopted

Table 7-2b Building Activity Source Energy Targets (EUIt1) (SI Units) - Not adopted

Table 7-2c Building Activity Electricity Site Energy Use Targets (ELUIt1) (I-P Units) - Not adopted

Table 7-2c Building Activity Electricity Site Energy Use Targets (ELUIt1) (SI Units) - Not adopted

Table 7-2d Building Activity Fossil Fuel Site Energy Use Targets (FEUIt1) (I-P Units) - Not adopted

Table 7-2d Building Activity Fossil Fuel Site Energy Use Targets (FEUIt1) (SI Units) - Not adopted

Table 7-3 Building Operating Shifts Normalization Factor

Table 7-3 adopted as modified in Section Z.

8. ENERGY AUDIT REQUIREMENTS

8.1 The qualified energy auditor shall complete Forms D and submit to the authority having jurisdiction (AHJ). If an energy audit is required within this section, a copy of the audit summary results shall be included in the compliance documentation in a format specified in Normative Annex Z. Compliance with this standard shall be achieved by adopting energy efficiency measures (EEMs) that collectively will reduce annual building energy use.

8.2 Energy Audit Requirements for Buildings without Energy Targets

8.2.1 Overall Process. An energy audit shall be conducted for all buildings not having an energy target. The energy audit and the associated energy audit report shall be completed by a qualified energy auditor practicing within their field of competency. The energy audit shall be a Level 2 audit (as defined in Section 8.4.2).

Exception to 8.2.1: *Buildings* that have completed an energy audit within the previous three years may use the results of the previous audit, provided that the scope of the energy audit meets the requirements of this section and that there have been minimal changes to the systems within the audit scope. The energy audit must be evaluated consistent with the investment criteria in Normative Annex X.

8.2.2 The scope of the energy audit shall include the following required end uses as applicable to the *building*:

- Envelope
- Lighting
- Cooling
- Heating
- Ventilation and exhaust systems
- Air distribution systems
- Heating, chilled, condenser, and domestic water systems
- Refrigeration except for food processing refrigeration
- Power generation equipment
- Uninterruptible power supplies and power distribution units
- People-moving systems
- The scope of the energy audit may include *campus district heating and/or cooling systems* when the *campus district heating and/or cooling system* serves the building being audited.

8.2.3 The following end uses are not included in this standard:

- *Industrial processes*
- *Agricultural processes*
- *Irrigation*

8.2.4 Following the completion of the energy audit, the *building owner* will select and implement *EEMs* per the requirements of Section 9.

8.3 Energy Audit Requirements for Buildings with Energy Targets

8.3.1 Buildings that Meet Their Energy Targets. *Buildings* that meet their *Energy targets* under Section 7 are not required to perform an energy audit.

8.3.2 Buildings that Do not Meet Their Energy Targets Overall Process. An energy audit shall be conducted, and an associated energy audit report shall be provided, for all buildings that do not meet their energy target. The energy audit shall be completed by a qualified energy auditor practicing within their field of competency. The energy audit shall be at an audit level specified by the qualified energy auditor to be sufficient to identify and evaluate the EEMs that, if implemented, would result in the building meeting its energy target. The qualified energy auditor may refer to the list of potential EEMs in Informative Annex E.

After the completion of the audit and the selection of EEMs to be implemented, the applicant must calculate an adjusted energy-use intensity (EUI) for the building based on the estimated energy savings from the selected EEMs and the historical energy use of the building. This adjusted EUI is then compared to the energy target for the building. If the adjusted EUI is less than the energy target, the applicant shall proceed with implementation as specified in Section 9. If the adjusted EUI is greater than the energy target, a more rigorous energy audit investigation is required to identify additional EEMs. This process is repeated until the building's adjusted EUI is less than its energy target.

Calculation of the adjusted EUI is shown in the following equation:

$$EUI_{adj} = (\text{Energy}_{hist} - \text{Energy}_{saved}) / \text{GFA}$$

where

Energy_{hist} = historical annual energy use, kBtu (MJ)

Energy_{saved} = estimated annual energy savings, kBtu (MJ)

GFA = gross floor area, ft² (m²)

Following the completion of an energy audit that has identified EEMs sufficient to meet the building's energy target, the applicant shall implement those EEMs per the requirements of Section 9.

Exception to 8.3.2: *Buildings* that have completed an energy audit within the previous three years may use the previous energy audit to identify *EEMs* for implementation, provided that the scope of the energy audit meets the requirements of this section and there have been minimal changes to the systems within the audit scope. In this case, the same comparison of adjusted *EUI* to *energy target* shall be made by the applicant. If the *EEMs* identified in the audit are still applicable, have not been implemented, and if implemented would result in the *building* meeting its *energy target*, these measures shall be implemented by the facility, and the project shall follow the procedures in Section 9. If the identified *EEMs* do not result in an adjusted *EUI* less than the *energy target*, a new energy audit shall be conducted as described Section 8.3.2.

8.4 Energy Audit Levels. This section outlines the requirements for Level 1 and Level 2 energy audits for *buildings*.

8.4.1 Level 1 Audit. Buildings shall perform a Level 1 audit (walk-through analysis) as defined in ANSI/ASHRAE/ACCA Standard 211-2018 Standard for Commercial Building Energy Audits, Section 5.3¹².

8.4.2 Level 2 Audit. Buildings shall perform a Level 2 Audit (energy survey and engineering analysis) as defined in ANSI/ASHRAE/ACCA Standard 211-2018 Standard for Commercial Building Energy Audits, Section 5.4¹².

8.4.2 Level 2 Audit. Buildings shall perform a Level 2 Audit (energy survey and engineering analysis) as defined in ASHRAE's *Procedures for Commercial Building Energy Audits*, 2nd Edition 5.

8.5 Energy Audit Report. This section prescribes the overall approaches and methods to be used in the energy audit report for audits completed under Sections 8.4.1 or 8.4.2.

8.5.1 Audit Results. The energy audit report shall define the actions necessary for the *building owner* to achieve the energy and cost savings that are recommended in the report.

Energy audit results shall be presented in a summary table that includes, at a minimum, an estimate of each of the following:

- A list of recommended EEMs that, if implemented, will either meet the energy target for the building if it has a target or, if it does not have an energy target, will meet the economic criteria set by the standard in Section 9.
- The estimated energy savings and peak demand savings associated with each recommended EEM, expressed in the cost units used on the building owner's energy bills, and the units used for comparison with the energy target.
- The estimated (modeled) energy cost savings associated with each recommended EEM.
- The estimated cost of implementation for each recommended EEM. The costs of implementation shall include the required monitoring of energy savings per the requirements of Section 9.

The economic evaluation of measures are required by Normative Annex X.

8.5.2 Interactive Effects. Energy savings analysis shall include interactive effects of all selected EEMs. When considering multiple EEMs with interactive effects, the order of analysis shall start with load reduction measures and proceed through distribution systems and associated equipment efficiencies and then plant and heat-rejection systems. Any interactive effects on equipment sizing and part load performance of equipment shall be accounted for due to reduced loads on subsequent systems.

8.5.3 Optimized Bundling. The *EEMs* recommended in the energy audit report shall consist of an *optimized bundle* of *EEMs*.

8.5.4 Financial Analysis. Financial analysis shall be made using current utility rate charges for the site. For customers who are charged based on time-of-use or peak demand (kW), cost analysis of those *EEMs* shall include appropriate treatment of the costs savings associated with the measures and reflect peak demand or time-of-use cost savings.

8.5.4.1 Nonfederal Facilities. The minimum financial criteria required for reporting is specified in Normative Annex X.

8.5.4.2 U.S. Federal Facilities. - Not adopted.

8.5.5 End-Use Analysis. The energy audit shall include an end-use analysis that compares the estimated energy use of the facility after implementation of all selected EEMs to historical utility consumption. The intent of this requirement is to ensure that estimates of the base-case end-use energy estimates and potential energy-savings estimates in the energy audit report are reasonable.

8.5.5.1 Requirements for Level 1 Audits. The analysis shall demonstrate that the sum of base-case end-use energy estimates total no more than the historical energy consumption for the end use at the site. This shall be done by completing the following:

- a. The historic energy use shall be apportioned into each of the end uses, such as HVAC, lighting, domestic hot-water, and plug loads.
- b. The *qualified energy auditor* shall verify that each *EEM* savings estimate is reasonable in comparison to the energy consumption of that end use based on energy consumption survey data or experience with similar sites.

End-use analysis shall be conducted for all fuel types at the site, such as electricity, natural gas, or fuel oil, for which *EEMs* are identified.

Informative Note: For example, if the audit identifies lighting retrofit opportunities, the *energy auditor* shall compare the identified energy savings for those opportunities with the base-case energy use of the facility and demonstrate that they make up a reasonable fraction of the historical electricity consumption at the site. (See Form D in Normative Annex C.)

8.5.5.2 Requirements for Level 2 Audits. The energy auditor is required to estimate the energy use of all end uses that individually comprise more than 5% of total historical building energy use. The energy estimates for these end uses shall be summed and compared to historical energy consumption for the facility. The sum of the base-case end-use energy estimates must be between 90% and 100% of the historical energy use at the site.

This comparison shall be conducted separately for each fuel type, such as electricity, natural gas, or fuel oil, for which EEMs are identified. On-site energy sources such as solar, photovoltaic, geothermal, and wind shall be included.

Correction for historical weather for the base year versus average weather used in baseline estimates may be used.

The same energy-use estimates that comprise the end-use analysis shall also be used as the basis for energy savings calculations. The qualified energy auditor shall verify that

each EEM savings estimate is reasonable in comparison to the historical energy consumption of that end use based on energy consumption survey data or experience with similar sites.

The qualified energy auditor shall verify that the combined savings from multiple EEMs shall take into account interactive effects among measures.

Miscellaneous plug loads may be estimated on average equipment power density and building area. (See Form D in Normative Annex Z.)

8.5.6 Baseline. The *baseline* for energy- and cost-savings estimates shall be taken to be the condition of the existing *building* at the time of the initial comparison with the *building's energy target* or at the time of the initial required audit. The energy-savings estimates shall be calculated as the difference between the energy use of proposed systems and the *baseline* energy-use estimates of those systems.

9. IMPLEMENTATION AND VERIFICATION REQUIREMENTS

9.1 Developing and Implementing an Energy Management Plan

9.1.1 Requirements. *Buildings* that have an energy target shall comply with the requirements of Section 9.1.1.1. Buildings that do not have an energy target shall comply with the requirements of Section 9.1.1.2. All buildings shall implement an energy management plan as described in Section 5. The energy management plan shall be integrated into the building's capital management plan as described in Section 5. The energy management plan shall include the elements listed in Section 5.

9.1.1.1 Buildings with Energy Targets. For *buildings* having energy targets, energy efficiency measures (EEMs) identified from the energy audit shall be implemented in order to meet the building's energy target. Develop a written plan for maintaining the building's energy-use intensity (EUI) at or below the energy target.

Exceptions to Section 9.1.1.1:

1. Buildings may demonstrate compliance by implementing all of the EEM's that achieve the investment criteria in Normative Annex X.
2. Implementation of EEMs to campus district heating and/or cooling system(s) in lieu of EEM's implemented directly to campus buildings is acceptable provided the energy audit demonstrates the energy savings from the campus district heating and/or cooling system EEMs will be greater than the EEMs identified for the buildings. Energy savings shall be measured as a reduction in Btu per year.

9.1.1.2 Buildings without Energy Targets. *Buildings* that do not have an energy target shall implement all of the EEM's that achieve the investment criteria in Normative Annex X.

Exception to 9.1.1.2: Implementation of EEMs to campus district heating and/or cooling system(s) in lieu of EEM's implemented directly to campus buildings is acceptable provided the energy audit demonstrates the energy savings from the campus district heating and/or cooling system EEMs will be greater than the EEMs identified for the buildings. Energy savings shall be measured as a reduction in Btu per year.

9.1.1.2.1 - Not adopted.

9.1.1.2.2 - Not adopted.

9.1.2 Implementing the Energy Management Plan. The sequence in which measures are implemented shall be evaluated so that *EEMs* take into account the impact of previously implemented *EEMs*.

9.1.2.1 Training of Building Staff. An ongoing written training plan shall be implemented. *Building* occupants and staff shall be trained, at a minimum, as established by the operations and maintenance (O&M) program defined in Section 6.

9.1.2.2 Multiple Buildings. For campuses having multiple *buildings* connected through one billing meter, a multiple-*building* plan shall be implemented to coordinate *EEM* implementation among the *buildings* and measurement of the *EUI* of the campus.

9.1.2.3 Implementation and Commissioning of EEMs. *EEMs* shall be implemented and commissioned in accordance with the Washington State Energy Code. The qualified energy auditor or qualified person shall review the commissioning report and certify that the EEMs are functioning as intended.

Informative Note: For guidance on commissioning protocols, refer to ASHRAE Guideline 0, The Commissioning Process, and ASHRAE Guideline 1.1, *HVAC&R Technical Requirements for the Commissioning Process*.

9.1.2.4 Energy efficiency sequencing. Implementation of EEMs shall be prioritized to take advantage of the life cycle of building systems and to minimize the disruption of building occupants. Delayed implementation shall be evaluated using the methodology included in Normative Appendix X and reported in the energy management plan.

9.2 Verification of Implemented EEMs

9.2.1 Verification of Implemented EEMs for Buildings with Energy Targets. Upon implementation of *EEMs*, the *building's EUI* shall be monitored until one full year's data demonstrate that *energy targets* have been met.

9.2.2 Verification of Implemented EEMs for Buildings without Energy Targets. Upon implementation of EEMs, the affected end-use systems shall be monitored for one year to verify EEM energy savings. The qualified energy auditor or qualified person shall review the results of the EEM energy monitoring and certify that the energy savings of the package of EEMs meets or exceeds 75% of the energy savings projected in the energy audit as required. For buildings unable to meet the requirements of Section 5.2 Building energy monitoring, the qualified energy auditor or qualified person shall provide verification using the methods of the International Performance Measurement & Verification Protocol 11 options A through D.

9.3 Compliance. The qualified person shall complete the compliance documentation as required in Normative Annex Z.

10. RESIDENTIAL BUILDINGS AND DWELLING UNITS - Not adopted.

11. Section 11- References.

1. ASHRAE. 2010. Performance Measurement Protocols for Commercial Buildings. Atlanta: ASHRAE.
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14. ASHRAE Guideline 1.2-2018 Technical Requirements for the Commissioning Process for Existing HVAC&R Systems and Assemblies

Normative Annex A - Not adopted.

Informative Annex B - Not adopted.

WAC 194-50-120 Normative Annex C Forms. For Washington State Compliance Normative Annex C forms adopted as modified and published in Normative Annex Z, Section Z7

(This annex 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.)

INFORMATIVE ANNEX D OPERATIONS AND MAINTENANCE REQUIREMENTS FOR BUILDING SYSTEMS AND ELEMENTS

D1. BUILDING ENVELOPE

D1.1 Operations and maintenance (O&M) requirements for the *building* envelope should include all applicable items in Section 6 plus the following.

D1.2 The *energy manager (EM)* should verify a *building* envelope inspection is performed at least once every three years. Corrective action should be taken as needed, including addressing all items below.

D1.3 Seal all exterior joints in the *building* envelope, and all around penetrations of the *building* envelope by utility services.

D1.4 Replace broken or missing windows.

D1.5 Repair or replace exterior door weather stripping, threshold, and door sweeps as needed.

D1.6 Seal or cap obsolete shafts, chimneys, and other air chases.

D1.7 Repair or replace existing door closers on exterior doors.

D1.8 The *EM* shall develop, document, and distribute procedures to *building* personnel for energy-efficient operation of exterior doors, loading docks, and operable windows.

D2. DOMESTIC HOT-WATER SYSTEMS

D2.1 General Requirements

D2.1.1 O&M requirements for domestic hot-water (DHW) systems include all applicable items in Section 6 plus the following.

D2.1.2 Securely and visibly locate a list of operating parameters, such as temperature set points, pressures, and operating schedule, at each piece of equipment.

D2.2 Hot-Water Heaters

D2.2.1 *Maintain* proper combustion efficiency—carry out a combustion analysis and carbon monoxide testing at least annually, and make necessary corrections to achieve rated efficiency and safety.

Exception to D2.2.1: The input capacity of the heater is less than 100,000 Btu/h (29,310 W)

D2.2.2 Deenergize booster heaters when the serviced equipment is not in use or is in standby mode. Make allowance for warm-up time in heater schedule.

D2.2.3 Control the DHW heater so that DHW temperature is maintained between 120°F (49°C) and 125°F (52°C).

Exceptions to D2.2.3:

1. Systems dedicated to serving equipment requiring higher water temperatures,
2. Systems that use a water heater to meet both domestic hot-water needs and space heating load.

D3. HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC) SYSTEMS

D3.1 Scope. The scope of Section D3 includes *HVAC* systems and components used to condition spaces within *buildings*. The O&M requirements for these systems and their components should minimize energy use over time, while providing heating, ventilation, and cooling as needed for *building* operations and occupant needs. The O&M requirements for these systems should be evaluated when *building* use or other changes are made that affect system operations.

D3.2 General Requirements

D3.2.1 O&M requirements for *HVAC* systems include all applicable items in Section 6 plus the following.

D3.2.2 Each O&M task should be performed in a safe and professional manner by *qualified* personnel. Tasks that require specialized expertise should be performed by personnel with the requisite expertise who are certified where required by code or regulation.

D3.2.3 O&M tasks should be performed twice per year, unless otherwise noted in this standard, or as recommended by the manufacturer.

D3.2.4 Securely and visibly display a list of operating parameters, such as temperature set points, pressures, and operating schedule, for each piece of equipment in the equipment room or the equipment location. For equipment located in other areas, the list of operating parameters should be located in a readily accessible location close to the equipment, such as the unit control panel, or at the equipment access point, such as the roof hatch.

D3.2.5 For systems using refrigerant, *maintain* the refrigerant charge per the manufacturer's requirements.

D3.2.6 Display and *maintain* a *service log* on each piece of equipment as a visible and waterproof document.

D3.2.7 The *EM* and/or *building operator* should schedule, verify, and record O&M evaluations of the *HVAC* systems, taking corrective action where indicated. Such evaluations should include the following.

D3.2.7.1 Poll occupants and users of the *HVAC* systems for any observations or operational issues that have occurred.

D3.2.7.2 Physically inspect the maintained systems and components.

D3.2.7.3 Analyze occupant complaints and how these relate to system operation.

D3.2.7.4 *Maintain* indoor environmental quality parameters that have been established for the *building*, including temperature, humidity, and ventilation.

D3.2.7.5 *Maintain* *HVAC* system rooms and spaces for proper and safe service access. Relocate any material or debris impeding access to the HVAC equipment. *Maintain* service lighting.

D3.2.7.6 *Maintain HVAC system* schedules to meet current requirements, including the following:

- a. Occupied mode
- b. Unoccupied mode, such as automatic shutdown, setup mode, setback mode
- c. Start mode, such as warm-up mode, cool-down mode, optimum start mode

D3.2.7.7 *Maintain HVAC system* electrical connections.

D3.2.7.8 *Maintain* equipment to avoid excessive mechanical noise and vibration.

D3.2.7.9 *Maintain* HVAC heat exchange surfaces for effective heat transfer.

D3.2.7.10 *Maintain* serviceable points of lubrication.

D3.2.7.11 Replace or clean filters in accordance with the manufacturer's recommended schedule or design pressure drop.

D3.2.7.12 *Maintain HVAC system* piping and duct systems against leakage.

D3.2.7.13 *Maintain* insulation on *HVAC system* piping and duct systems.

D3.2.7.14 *Maintain* the steam water heating, hot-water heating, and chilled-water cooling control valves against leakage a minimum of once every three years.

D3.2.8 Document periodic maintenance work and service work on *service logs*.

D3.3 Boiler Systems. The scope of this section covers the operation and maintenance of boilers, flues/vents, feed water equipment, piping, valves, steam traps, strainers, all fittings, and components comprising the entire system.

D3.3.1 O&M requirements for boiler systems include all applicable items in Section 6 plus the following.

D3.3.1.1 Boiler Burners

- a. *Maintain* proper combustion efficiency—carry out a combustion analysis and carbon monoxide testing at least annually, and make necessary corrections to achieve rated efficiency and safety.
- d. For boilers $\geq 400,000$ Btu/h (117,240 W), design input, perform combustion analysis, and make adjustments to optimize boiler efficiency at least once annually.
- e. For boilers $< 400,000$ Btu/h (117,240 W), design input, perform combustion analysis, and make adjustments to optimize boiler efficiency at least once every three years.
- b. *Maintain* burners.
- c. *Maintain* combustion chamber to avoid incomplete combustion.
- f. Inspect combustion chamber against cracks or deterioration.
- d. *Maintain* pilot and flame controls, flues, combustion air openings, and safeties.
- e. *Maintain* boiler blowdown to ensure it is functional and not excessive.

D3.3.2 Boiler Controls

D3.3.2.1 Adjust controls to cycle the boiler system through an entire heating cycle and *maintain* proper operation.

D3.3.2.2 *Maintain* reset controls.

D3.3.2.3 *Maintain* heating operations so they do not result in short or rapid cycling of the burners.

D3.3.3 Venting

D3.3.3.1 *Maintain* combustion and ventilation air openings.

D3.3.3.2 *Maintain* boiler vent discharge and intakes.

D3.3.4 Steam and Condensate Return Loop

D3.3.4.1 *Maintain* condensate return systems.

D3.3.4.2 *Maintain* feed water systems.

D3.3.4.3 *Maintain* pressure relief and venting.

D3.3.4.4 *Maintain* steam traps.

D3.3.4.5 *Maintain* water treatment.

D3.3.5 Hot-Water Hydronic Loop

D3.3.5.1 *Maintain* pump operation and sequencing.

D3.3.5.2 *Maintain* water systems makeup and relief.

D3.3.5.3 *Maintain* system water pressure.

D3.3.5.4 *Maintain* system free of leaks and entrained air.

D3.3.5.5 *Maintain* water treatment and antifreeze additives.

D3.4 Chilled-Water Systems. The scope of this section covers the operation and maintenance of chillers, condensers, open- and closed-type cooling towers, pumps, valves, strainers, piping, and all fittings and components comprising the entire system.

D3.4.1 Chillers

D3.4.1.1 *Maintain* refrigeration system for proper temperatures and pressures.

D3.4.2 Chilled-Water System Controls

D3.4.2.1 *Maintain* controls to cycle the chilled-water system through an entire cooling cycle and verify proper operation.

D3.4.2.2 *Maintain* flow controls, operating controls, and safeties for proper operation.

D3.4.2.3 *Maintain* reset and head pressure controls for proper operation.

D3.4.2.4 Where cooling is provided by multiple units, *maintain* proper sequencing to achieve maximum efficiency while meeting required load.

D3.4.3 Chilled-Water Hydronic Loop

D3.4.3.1 *Maintain* proper water temperatures during operation.

D3.4.3.2 *Maintain* proper pump operation and sequencing.

D3.4.3.3 *Maintain* proper system water pressure.

D3.4.3.4 *Maintain* the entire system and ensure the distribution system is free of leaks and entrained air.

D3.4.3.5 *Maintain* water treatment.

D3.4.4 Cooling Towers and Condenser Water Loop

D3.4.4.1 *Maintain* proper water temperatures during operation.

D3.4.4.2 *Maintain* proper pump operation and sequencing.

D3.4.4.3 *Maintain* the entire system and ensure the distribution system is free of leaks and entrained air.

D3.4.4.4 *Maintain* water treatment, bleed control, and cycles of concentration.

D3.3.2 Boiler Controls

D3.3.2.1 Adjust controls to cycle the boiler system through an entire heating cycle and *maintain* proper operation.

D3.3.2.2 *Maintain* reset controls.

D3.4.4.5 *Maintain* corrosion coupon consumption.

D3.4.4.6 *Maintain* cooling tower sump.

D3.4.4.7 *Maintain* proper fan operation.

D3.5 Air-Side Heating, Cooling, and Ventilating Systems. The scope of this section covers the operation and maintenance of air-side heating, cooling, and ventilating systems ducting; terminal units; and components comprising the entire system.

D3.5.1 Air-Handling Systems

D3.5.1.1 *Maintain* all airflow components, including motors, fans, variable-frequency drives, inlet vanes, drain pans, piping, ductwork, dampers, louvers, coils, energy recovery devices, and cabinets, as applicable.

D3.5.1.2 *Maintain* controls, including sensors and actuators, and proper sequence of operation.

D3.5.1.3 *Maintain* heat exchange devices, including coils.

D3.5.1.4 *Maintain* damper systems.

D3.5.2 Heat Recovery Systems Including Energy Recovery Ventilation (ERV) and Heat Recovery Ventilation (HRV)

D3.5.2.1 See Section D3.5.1 as applicable.

D3.5.2.2 *Maintain* correct physical operation, such as wheel rotation, as applicable.

D3.5.3 Humidification

D3.5.3.1 *Maintain* fill and drain systems.

D3.5.3.2 *Maintain* water compartment for proper operation.

D3.5.3.3 *Maintain* sprayers and nozzles.

D3.5.3.4 *Maintain* sumps.

D3.5.3.5 *Maintain* control valve and steam traps.

D3.6 Perform heat exchanger testing on furnace heat exchangers at a minimum of once every three years per AHRI Guideline X, *Induced Draft Furnace Heat Exchanger Inspection 7*.

D3.7 Review occupant hot/cold complaints and operator hot/cold observations. If the complaint is validated, do the following.

D3.7.1 Check the *HVAC system* equipment operation.

D3.7.2 Review draft problems.

D3.7.3 Review zoning conflicts.

D3.7.4 Test the *zone* for good and stable temperature control.

D3.7.5 Measure the humidity level to verify it is below the ASHRAE Standard 55⁸ upper dew-point limit of 62.2°F (16.8°C).

D3.7.6 Adjust diffusers and other parts of heating and cooling distribution systems to minimize overheating and overcooling of rooms and *zones*.

D3.8 *Maintain* economizer systems.

D3.8.1 Check that dampers move freely through their entire operating range. Clean, lubricate, adjust, and repair as necessary.

D3.8.2 *Maintain* damper blades and side seals.

D3.8.3 *Maintain* wiring.

D3.8.4 *Maintain* controls, including sensors, wiring, pneumatic tubing and their connections, damper actuators, damper linkages, and damper sequencing for proper operation.

D3.9 Unitary Systems and Air-Handling Systems

D3.9.1 See Section D3.5.1 as applicable.

D3.9.2 *Maintain* system heating and cooling operation.

D3.9.3 *Maintain* controls for proper sequence of operations.

D3.9.4 *Maintain* condensate drain pan and piping.

D3.9.5 *Maintain* direct-expansion cooling or heating.

D3.9.6 Refer to Section D4 for direct-expansion refrigerant-based systems.

D3.10 Evaporative Cooling Systems

D3.10.1 See Section D3.5.1 as applicable.

D3.10.2 *Maintain* proper fill and drain operation.

D3.10.3 *Maintain* water compartment moisture and air containment.

D3.10.4 *Maintain* sprayers, nozzles, evaporative media, and water distribution components for proper operation.

D3.10.5 *Maintain* drains and clean sumps.

D3.10.6 *Maintain* proper system heating, heat recovery, and cooling operation.

D3.10.7 *Maintain* controls for proper sequence of operations.

D3.11 Geothermal Systems

D3.11.1 See Sections D3.5.1 and D3.9 as applicable.

D3.11.2 *Maintain* system heating and cooling operation.

D3.12 Terminal Systems

D3.12.1 See D3.5.1 as applicable.

D3.12.2 *Maintain* system heating and cooling operation.

D3.13 Thermal Energy Storage Systems. The scope of this section covers thermal energy storage systems, ice-storage systems, phase-change storage systems, hot-water storage systems, and heat storage systems (e.g., using thermal mass).

D3.13.1 *Maintain* all equipment in accordance with requirements for each type of equipment elsewhere in this section.

D3.13.2 Operate the thermal energy storage system through its entire cooling and/or heating cycle and verify proper operation of all controls. Perform adjustments and repairs as necessary.

D4. REFRIGERATION SYSTEMS

D4.1 Scope. The scope of Section D4 includes the operation and maintenance of refrigeration systems and equipment that do not supply comfort cooling, such as display case refrigeration systems, refrigerated warehouses, and all medium- and low-temperature-product refrigeration systems.

D4.2 Operations and Maintenance. O&M requirements for refrigeration systems include all applicable items in Section D6.1 plus the following.

D4.2.1 Monitor refrigerating systems at regular intervals, determined by the type of system and historic leakage rates, to ensure that systems are well sealed, have the correct refrigerant charge, and are operating properly. Take the following actions as applicable.

D4.2.2 Securely and visibly locate a list of operating parameters, such as temperature set points, pressures, and operating schedule, at each piece of equipment.

D4.2.3 Check for refrigerant leaks using industry standard procedures.

D4.2.4 Monitor and record all additions of refrigerant to, or removals from, the system, along with the reason for the action.

D4.2.5 *Maintain* the refrigerant charge within the manufacturer's specified range.

D4.3 *Maintain* evaporator defrost system for proper operation.

D4.4 Retail Store Product Display Refrigeration Systems

D4.4.1 *Maintain* refrigeration systems.

D4.4.2 The *EM* should work with staff to ensure they know correct product loading practices for display refrigerators. Avoid uneven loading, overloading, blocked air curtains, or blocked return air paths.

D4.4.3 In stores that are not open 24 hours a day, *maintain* the use of night covers for display cases and refrigerators to minimize ambient air infiltration.

D4.5 Walk-In Coolers and Freezers

D4.5.1 *Maintain* refrigeration system.

D4.5.2 *Maintain* doors, including hinges, gaskets, and closures.

D4.5.3 *Maintain* evaporator and condenser coils.

D4.5.4 *Maintain* evaporator drains lines. In freezers, *maintain* the drain line heat tape to operate properly, and *maintain* the drain line insulation in good condition.

D4.5.5 *Maintain* the defrost operation, including frequency. Schedule defrost to avoid activation during peak demand periods.

D4.5.6 *Maintain* the interior of refrigerated enclosures for punctured or broken panels and breaches around pipe or wiring penetrations; *maintain* vapor barrier integrity.

D4.5.7 Encourage users to turn lights off when the room is vacant.

D4.6 Ice-Making Machines

D4.6.1 *Maintain* refrigeration systems.

D4.6.2 *Maintain* water system, reservoir, and evaporator coil for scale or mineral build-up and proper operation.

D4.6.3 *Maintain* strainer, inlet water valve screen, and float valve for proper operation.

D4.6.4 *Maintain* air filter, condenser coil, and condenser fan.

D4.6.5 *Maintain* the bin ice control for proper operation, including drain and water overflow.

D4.7 Refrigerated Warehouses

D4.7.1 *Maintain* refrigeration systems.

D4.7.2 The *EM* should work with users so that product is located to permit air circulation, particularly near walls and ceiling.

D4.7.3 Examine walls and ceiling monthly for evidence of frost build up. Locate the source and make corrective repairs.

D4.7.4 *Maintain* doors, rollers, door travel, and threshold as needed to minimize door leakage.

D4.7.5 *Maintain* the interior of refrigerated enclosures for punctured or broken panels and breaches around ducts, pipe, or wiring penetrations; *maintain* vapor barrier integrity.

D5. LIGHTING SYSTEMS

D5.1 The O&M program should include a lighting systems section. The lighting systems plan should include, as a minimum, the requirements listed in Section D5, which should be implemented at the time of compliance with this section and at three-year intervals thereafter.

D5.2 Lighting Controls. The *EM* should inventory and verify correct operation, programming, and placement of all lighting controls. Lighting controls that have been disabled should be repaired and made functional. Functional testing should be performed on *dimmers*, *multiscene controls*, *occupancy sensors*, time switches, or *photosensors*, if present, in accordance with the requirements of Section 9.4.4 of ASHRAE/IES Standard 90.1.

D5.3 Luminaire Integrity. The *EM* should survey all existing *luminaires* and create an as-built *lighting schedule*. This *lighting schedule* may be developed using a lighting survey tool. The *EM* should calculate and document the *lighting power density* and compare with any previous *lighting power density* calculation, such as those from original design documents or from previous *lighting schedules*. Continued compliance with this section requires that the *lighting power density* does not increase with time unless there is a corresponding, documented change in use of the space.

D5.4 The current *lighting schedule* should be evaluated for opportunities for energy savings through implementation of *energy efficiency measures (EEMs)*, such as those listed in Informative Annex E, Section 6 (nonresidential), or Section 7 (residential), and an estimate of the energy savings should be prepared. This estimate will be included in the energy management plan (see Section 5.1.2.12 if an energy management plan is required).

D5.5 Occupant Training

D5.6 Lighting Maintenance. The O&M program should specify the following:

- a. Replacement of failed *lamps* and ballasts.
- b. Replacement of failed *luminaires*.
- c. Periodic cleaning of all optical surfaces, including lenses, reflectors, louvers, and shielding mechanisms, as well as *lamps*. Individual luminaries should be cleaned whenever *lamps* or ballasts are replaced, and all luminaries as a group should be cleaned at least once every three years. All such cleaning should be performed in accordance with manufacturer's instructions if available.
- d. Any *lamp* or ballast replacement within the existing *luminaires* in a space should not increase the installed interior *lighting power density* of the space unless the previous light levels were less than the IES recommended levels as specified in the IES *Lighting Handbook*⁴ or in the IES *Recommended Practices* title for that space type. If the exact space type cannot be found, then the space type with the closest functional activities should be used.
- e. For exterior residential lighting, all replacement *lamps* should be *high-efficacy lamps* unless controlled to auto-

matically limit power use to less than 2200 total hours of full-power operation per year.

f. For nonresidential exterior lighting, turn off all exterior lighting during *daylight hours*.

Exceptions to D5.6(f):

1. Signage.
2. Lighting needed for safety.
3. Lighting needed for operational necessity.

D5.7 Interior Lighting in Nonresidential Buildings. A lighting satisfaction survey should be conducted at least every three years and key issues identified and corrected as necessary.

D6. CONTROLS SYSTEMS

D6.1 Scope. The scope of Section D6 includes all types of control and energy management systems and components used to control conditioned spaces within *buildings*.

The O&M requirements for these systems and their components should minimize energy use over time while providing control of equipment and systems as needed for *building* operations and occupant needs. The O&M requirements for these systems should be reevaluated when *building* use or other changes are made that negatively affect the systems' operations.

D6.2 All equipment should be maintained according to the manufacturer's instructions.

D6.2.1 Each O&M task should be performed safely and in accordance with good trade practice by *qualified* personnel. Tasks that require specialized expertise should be performed by personnel with the requisite expertise and who are appropriately certified where required by code or regulation.

D6.2.2 O&M tasks should be performed twice per year, unless otherwise noted in this standard, or as recommended by the manufacturer.

D6.2.3 The *EM* and/or *building operator* should schedule and perform evaluations of the control systems twice per year. System evaluations shall include the following:

- a. Reviewing recorded trouble calls and occupant complaints and analyzing how these relate to control operation.
- b. Physically inspecting maintained systems and components.
- c. Checking that all set points are correct per efficiency requirements, design, or the owner's needs.
- d. Checking to ensure seasonal control changes are adjusted.
 - e. Checking that time of day and holiday schedules are optimized to meet current occupied hours.
 - f. Making calibration checks of all system-level sensors, including hot-water, chilled-water, and

multiple-*zone* air-handling units, at least every three years.

g. Making calibration checks of all space sensors showing small drift or offset over time at least once every five years.

h. Checking whether controls are overridden or in manual operation and making corrections as necessary.

i. Checking the control of minimum outdoor air ventilation and making adjustments where necessary to avoid either excessive or inadequate minimum outdoor airflows. C

D6.2.4 Correct all issues found during the control system evaluations.

D6.3 Pneumatic Controls (including Pneumatic Sensors and Actuators)

D6.3.1 Check for properly operating receivers controllers and transducers and calibrate as required.

D6.3.2 Check for oil in the air lines and clean lines and any affected components as required.

D6.3.3 Check filters on air dryer and clean or replace as necessary.

D6.3.4 Check condenser coil on the air dryer and clean as necessary.

D6.3.5 Check pressure reducing valves (PRV or regulator) operation and calibrate as required.

D6.3.6 Check for leaks in air storage tank.

D6.3.7 Check tank condensate drain operation.

D6.3.8 Check thermostat for proper operation and calibrate as required.

D6.3.9 Check system for leaks in the high pressure lines.

D6.3.10 Check compressor run time; it should run less than 50% of the time. If runtime is excessive, check for leaks or other causes of high demand for control air and take corrective action as needed.

D6.3.11 Correct all issues found during the pneumatic control system evaluations.

D6.4 Analog Controls

D6.4.1 Check differential pressure gages operation.

D6.4.2 Check differential pressure switches operation.

D6.4.3 Check air pressure switches operations. **D6.4.4**

Check thermostat operation.

D6.4.5 Check transformer input and output voltages.

D6.4.6 Check system's back-up batteries.

D6.4.7 Correct all issues found during the *analog control* system evaluations.

D6.5 Direct Digital Controls (DDC) (including Electronic Sensors and Actuators)

D6.5.1 Review *DDC* system applications programs and verify the system is working in accordance with the design sequence of operation.

D6.5.2 Confirm component readings are in range through audits, calibration, or comparison to performance standards.

D6.5.3 If the *DDC* system has back-up batteries, check system's back-up batteries.

D6.5.4 Inspect, clean, and *maintain* all sensors and meters in conformance with the manufacturer's recommendations.

D6.5.5 Verify the most recent calibration report of CO₂ sensors and recalibrate as recommended by the manufacturer.

D6.5.6 Check whether outdoor devices have adequate enclosures and whether the enclosures are in good conditions.

D6.5.7 Verify input and output transformer voltages.

D6.5.8 Verify control actuation, linkage attachment, stroke timing, and torque required for motor actuators.

D6.5.9 Correct all issues found during the *DDC* system evaluations.

D7. ELECTRIC POWER DISTRIBUTION AND ON-SITE GENERATION SYSTEMS

D7.1 Scope. The scope of Section D7 covers aspects of O&M for the *building* electrical power system that relate to the facility's energy efficiency.

D7.2 O&M requirements for electric power distribution and on-site generation systems include all applicable items in Section D6.1 plus the following.

D7.3 Each piece of on-site electrical generation equipment or built-up system should be maintained to the manufacturer's instructions.

D7.4 Metering and Submetering. Meters and submeters owned by the facility should be calibrated at least once every five years per the manufacturer's instructions.

D7.5 On-Site Electricity Generation

D7.5.1 Fuel-Fired Cogeneration. A monthly record of cogeneration operating hours and heat recovery should be maintained and reported annually. Annual energy generated and useful heat recovered should be compared to the design estimates for these values.

D7.5.2 Photovoltaic (PV) Systems. PV system performance should be reported on an annual basis. The annual output should be compared to the system's designed output or output during previous operating periods. Shortfalls in annual system performance should be analyzed for cause and possible system defects, and troubleshooting and corrective work should be performed as necessary.

D7.5.3 Fuel Cells. Fuel cell performance should be reported on a monthly basis. Shortfalls in monthly system performance should be analyzed for cause and possible system defects, and troubleshooting and corrective work should be performed as necessary.

(This annex 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.)

INFORMATIVE ANNEX E ENERGY EFFICIENCY MEASURES

This informative annex provided categorized listings of typical *energy efficiency measures (EEMs)* that can be applied to enable *buildings* to meet the set *energy targets*. It identifies commonly applied elements that can improve *building* performance but is not intended to suggest specific requirements, nor does it comprehensively cover all of the options available to an owner.

Measures included in these listings are intended to improve energy efficiency and reduce overall energy use. They are not intended to encourage fuel switching unless such actions as installation of cogeneration, trigeneration, or combined heating and cooling plants would result in overall reduction in total energy used.

Some measures, such as demand response/control, may also save energy as an incidental side benefit. Other measures may result in extension of the capacity of given infrastructure systems and/or the ability for energy efficiency to defer or eliminate the need for plant expansions. Such results can be factored into the resulting return on investment or life-cycle cost analysis.

E1. BUILDING ENVELOPE

E1.1 Walls

E1.1.1 Insulate Walls. Retrofit insulation can be external and internal.

E1.1.1.1 External post insulation makes large savings possible, as this type of insulation contributes not only to a reduction of the heat loss through large wall surfaces but also eliminates the traditional thermal bridges where floor and internal wall are anchored in the exterior wall.

E1.1.1.2 Internal insulation is typically used when external insulation is not allowed, such as for historical *buildings*.

E1.1.2 Insulate cavity walls using spray-in insulation.

E1.1.3 Consider converting internal courtyard into an atrium to reduce external wall surface.

E1.2 Roofs

E1.2.1 Use cool roof (high-reflectance roofing material) with reroofing projects.

E1.2.2 Determine roof insulation values and recommend roof insulation as appropriate.

E1.2.3 Insulate ceilings and roofs using spray-on insulation.

E1.2.4 Where appropriate, exhaust hot air from attics.

E1.3 Floors

E1.3.1 Insulate floors.

E1.3.2 Insulate floors using spray-on insulation.

E1.3.3 Insulate basement wall with a slab over unheated basement.

E1.4 Windows

E1.4.1 Replace single-pane and leaky windows with thermal/operable windows to minimize cooling and heating loss.

E1.4.2 Install exterior shading, such as blinds or awnings, to cut down on heat loss and to reduce heat gain.

E1.4.3 Install storm windows and multiple glazed windows.

E1.4.4 Use tinted or reflective glazing or energy control/solar window films.

E1.4.5 Replace existing fenestration (toplighting and/or sidelighting) with dual-glazed low-e glass wherever possible to reduce thermal gain.

E1.4.6 Adopt weatherization/fenestration improvements.

E1.4.7 Consider replacing exterior windows with insulated glass block when visibility is not required but light is required.

E1.4.8 Landscape/plant trees to create shade and reduce air-conditioning loads.

E1.5 Doors

E1.5.1 Prevent heat loss through doors by draft sealing and using thermal insulation.

E1.5.2 Install automatic doors, air curtains, or strip doors at high-traffic passages between conditioned and unconditioned spaces.

E1.5.3 Use self-closing or revolving doors and vestibules if possible.

E1.5.4 Install high-speed doors between heated/cooled *building* space and unconditioned space in the areas with high-traffic passages.

E1.6 Install separate smaller doors for people near the area of large vehicle doors air leakage.

E1.6.1 Seal top and bottom of *building*.

E1.6.2 Seal vertical shafts, stairways, outside walls, and openings.

E1.6.3 Compartmentalize garage doors and mechanical and vented internal and special-purpose rooms.

E1.7 Moisture Penetration

E1.8 Reduce air leakage.

E1.9 Install vapor barriers in walls, ceilings, and roofs.

E2. HVAC SYSTEMS

E2.1 Ventilation

E2.1.1 Reduce *HVAC system* outdoor airflow rates when possible. Minimum outdoor airflow rates should comply with ASHRAE Standard 62.1⁹ or local code requirements.

E2.1.2 Reduce minimum flow settings in single-duct and dual-duct variable-air-volume (YAY) terminals as low as is practical to meet ventilation requirements.

E2.1.3 Minimize exhaust and makeup (ventilation) rates when possible by complying with the most stringent federal, state, and/or local code requirements.

E2.1.4 When available, use operable windows for ventilation during mild weather (natural ventilation) when outdoor

conditions are optimal. Confirm that the facility has been designed for natural ventilation and that control strategies are available to operate the facility in the natural ventilation mode.

E2.1.5 Eliminate outdoor air ventilation during unoccupied *building* morning warm up.

E2.1.6 Convert mixing air supply systems into displacement ventilation systems to create a temperature stratification in spaces with high ceilings and predominant cooling needs.

E2.1.7 Consider replacement of all-air *HVAC system* with a combination of a dedicated outdoor air system coupled with radiant cooling and heating systems.

E2.1.8 Convert constant-volume central exhaust systems into demand-based controlled central exhaust systems when possible.

E2.1.9 Convert *HVAC systems* to provide ventilation in accordance with ASHRAE Standard 62.1 9.

E2.2 HVAC Distribution Systems

E2.2.1 Convert a constant-air-volume system (CAV) (including dual duct, multizone, and constant-volume reheat systems) into a VAV system with variable-speed drives (VFDs) on fan motors. A VAV system is designed to deliver only the volume of air needed for conditioning the actual load.

E2.2.2 Control VAV system VFD speed based on the static pressure needs in the system. Reset the static pressure set point dynamically as low as is practical to meet the *zone* set points.

E2.2.3 Reset VAV system supply air temperature set point when system is at minimum speed to provide adequate ventilation.

E2.2.4 If conversion to VAV from CAV systems is impractical, reset supply air temperatures in response to load. Dynamically control heating duct temperatures as low as possible, and cooling duct temperatures as high as possible, while meeting the load.

E2.2.5 Use high-efficiency fans and pumps; replace or trim impellers of existing fans if they have excessive capacity relative to peak demand.

E2.2.6 Install higher-efficiency air filters/cleaners in *HVAC system*. Size ducts and select filter sizes for low face velocity to reduce pressure drop where available space permits.

E2.2.7 Insulate HVAC ducts and pipes, particularly where they are outside the *conditioned space*. Ensure that duct insulation and vapor barrier are maintained or enhanced to ensure thermal performance and avoid water vapor intrusion.

E2.2.8 Check for air leaks in HVAC duct systems and seal ductwork as indicated.

E2.2.9 Rebalance ducting and piping systems.

E2.2.10 Provide cooling effect by creating air movement with fans.

E2.2.11 Select cooling coils with a face velocity range of 300 to 350 fpm (1.5 to 1.75 m/s) to reduce the air pressure drop across the cooling coil and increase the chilled-water system temperature differential across the system.

E2.2.12 Replace standard fan belts with fan belts designed for minimum energy losses, such as cog belts.

E2.2.13 Eliminate or downsize existing HVAC equipment in an existing *building* or group of *buildings* when improvements in *building* envelope, reductions in lighting or plug loads, and other *EEMs* that reduce cooling or heating loads have been implemented.

E2.2.14 Eliminate HVAC use in vestibules and unoccupied spaces.

E2.2.15 Minimize direct cooling/heating of unoccupied areas by system *zone* controls, *occupancy sensors*, or by turning off fan-coil units and unit heaters.

E2.2.16 Replace forced-air heaters with low- or medium-temperature radiant heaters.

E2.2.17 Replace inefficient window air conditioners with high-efficiency (i.e., high SEER rating) modular units or central systems.

E2.2.18 Employ heat recovery from exhaust air and processes for preheating or precooling incoming outdoor air or supply air.

E2.2.19 Install transpired air heating collector (solar wall) for ventilation air preheating.

E2.2.20 Modify controls and/or systems to implement night precooling to reduce cooling energy consumption the following day.

E2.2.21 Use waste heat, such as hot gas, return air heat, or return hot water, as an energy source for reheating for humidity control. (Often air is cooled to dew-point to remove moisture and then must be reheated to desired temperature and humidity.)

E2.2.22 Avoid temperature stratification with heating, either by proper air supply system design or by using temperature destratifiers such as ceiling fans.

E2.2.23 In humid climates, supply air with a temperature above the dew point to prevent condensation on cold surfaces.

E2.2.24 Insulate fan-coil units and avoid their installation in unconditioned spaces.

E2.2.25 Clean heat exchangers (to *maintain* heat exchange efficiency) in the evaporators and condensers of refrigeration equipment on a seasonal basis.

E2.2.26 Use high-efficiency dehumidification systems based on either dedicated outdoor air systems (DOAS) or VAV systems.

E2.2.27 Identify whether there are any rogue *zones* (i.e., *zones* that determine the cooling or heating demand on the entire system) in a multiple-*zone* air-handling system, and modify them to eliminate their negative impact.

E2.2.28 Modify supply duct systems to eliminate duct configurations that impose high friction losses on the system.

E2.2.29 Convert three-pipe heating/cooling distribution systems to four-pipe or two-pipe systems. Eliminate simultaneous heating and cooling through mixed returns.

E2.2.30 Convert steam or compressed air humidifiers to ultrasonic or high-pressure humidifiers.

E2.2.31 Replace mechanical dehumidification with desiccant systems using heat-recovery regeneration.

E2.2.32 Consider small unitary systems for small *zones* with long or continuous occupancy. Avoid running large distribution systems to meet needs of small, continuously occupied spaces.

E2.2.33 Install thermostatic control valves on uncontrolled or manually controlled radiators.

E2.2.34 Replace unitary systems with newer units with high efficiency and high SEER ratings.

E2.2.35 Install evaporative precooling for direct-expansion (DX) systems.

E2.2.36 Install air-side heat recovery for systems using 100% makeup air, such as run-around piping or energy exchange wheels.

E2.2.37 In reheat systems, make adjustments as necessary to minimize reheat energy consumption while maintaining indoor environmental quality.

E2.2.38 In multiple-*zone* systems, identify any rogue *zones* that consistently cause the reset of system-level set points in order to satisfy that one *zone*'s heating or cooling demands.

E2.3 Building Automation and Control Systems

E2.3.1 Create *building/air-conditioned space zones* with separate controls to suit solar exposure and occupancy.

E2.3.2 Use night setback, or turn off HVAC equipment when *building* is unoccupied.

E2.3.3 Install *occupancy sensors* with VAV systems; setback temperatures and shut off boxes.

E2.3.4 Install system controls to reduce cooling/heating of unoccupied space.

E2.3.5 Lower heating and raise cooling temperature set points to match the comfort range prescribed in ASHRAE Standard 55.8.

E2.3.6 Install an air-side and/or water-side economizer cycle with enthalpy switchover when compatible with the existing equipment, space occupancy, and distribution system.

E2.3.7 Schedule off-hour meetings in a location that does not require HVAC in the entire facility.

E2.3.8 Retrofit multiple-*zone* VAV systems with *direct digital controls (DDC)* controllers at the *zone* level, and implement supply air duct pressure reset to reduce supply air duct pressure until at least one *zone* damper is nearly wide open.

E2.3.9 Eliminate duplicative *zone* controls such as multiple thermostats serving a single *zone* with independent controls.

E2.3.10 Adjust hot-water and chilled-water temperature to develop peak-shaving strategies based on an outdoor air temperature reset schedule.

E2.3.11 Adjust housekeeping schedule to minimize HVAC use.

E2.3.12 Install programmable *zone* thermostats with appropriate deadbands.

E2.3.13 Use variable-speed drives (VSDs) and *DDC* on water circulation pump and fan motors and controls.

E2.3.14 Reduce operating hours of complementing heating and cooling systems. Ensure proper location of thermostat to provide balanced space conditioning.

E2.3.15 Implement an energy management system (EMS) designed to optimize and adjust HVAC operations based on environmental conditions, changing uses, and timing.

E3. REFRIGERATION

E3.1 Reduce Loads

E3.1.1 Install strip curtains or automatic fast open and close doors on refrigerated space doorways.

E3.1.2 Replace open refrigerated cases with reach-in refrigerated cases.

E3.1.3 Replace old refrigerated cases with new high-efficiency models (improved glazing, insulation, motor efficiency, and reduced antisweat requirements).

E3.1.4 Replace worn door gaskets.

E3.1.5 Replace broken or missing automatic door closers.

E3.1.6 Check defrost schedules and avoid excessive defrost.

E3.1.7 Repair/install refrigeration piping insulation on suction lines.

E3.1.8 Install humidity-responsive antisweat heating (ASH) controls on refrigerated case doors.

E3.1.9 Install refrigerated case, walk-in, or storage space lighting controls (scheduled and/or *occupancy sensors*).

E3.1.10 Install night covers to reduce infiltration in open cases.

E3.1.11 Install low/no ASH refrigerated case doors.

E3.1.12 Replace lights with LED strip lights with *motion sensors* in refrigerated cases and spaces.

E3.1.13 Increase insulation on walk-in boxes and storage spaces that have visible moisture or ice on walls, corners, etc. Ensure that insulation and vapor barrier are maintained or enhanced to ensure thermal performance and avoid water vapor intrusion.

E3.2 Improve System Operating Efficiency

E3.2.1 Clean condenser coils.

E3.2.2 Check the refrigerant charge and add when needed.

E3.2.3 Reclaim heat from hot-gas line for domestic water heating or space heating.

E3.2.4 Install floating-head pressure controls, adjustable-head pressure control valve, and balanced port expansion valves for DX systems.

E3.2.5 Install floating suction pressure controls on DX systems.

E3.2.6 Install evaporator fan motor VSDs and controllers in walk-ins and refrigerated storage spaces.

E3.2.7 Replace single-phase, <1 hp evaporator fan motors with electrically commutated motors.

E3.2.8 Replace three-phase evaporator and condenser motors with premium efficiency motors.

E3.2.9 Replace single compressor systems with multiplex systems and control system.

E3.2.10 Install mechanical subcooling.

E3.2.11 Install mechanical unloaders on appropriate multiplex reciprocating semihermetic compressors.

E3.2.12 Install VFD on ammonia screw compressors.

E3.2.13 Install high specific-efficiency (Btu/W) condensers. **E3.2.14** Install hybrid air-cooled/evaporative-cooled condensers.

E4. WATER SYSTEMS

E4.1 Domestic Hot-Water Systems

- E4.1.1** Lower domestic water set point temperatures to 120°F (49°C)
- E4.1.2** Install point-of-use gas or electric water heaters.
- E4.1.3** Install water-heater blankets on water heaters.
- E4.1.4** Where permitted by the manufacturer, and in conjunction with the manufacturer's control system, install automatic flue dampers on fuel-fired water heaters.
- E4.1.5** Insulate hot-water pipes.
- E4.1.6** Reclaim heat from waste water, refrigeration systems, cogeneration, or chillers.
- E4.1.7** Install solar heating where applicable.
- E4.1.8** Replace dishwashers by installing low-temperature systems that sanitize primarily through chemical agents rather than high water temperatures.
- E4.1.9** Retrofit dishwashers by installing electric-eye or sensor systems in conveyor-type machines so that the presence of dishes moving along the conveyor activates the water flow.
- E4.1.10** Reduce operating hours for water-heating systems.
- E4.1.11** Install gray water heat recovery from showers, dishwashers, and washing machines.
- E4.1.12** Install low-flow dishwashing prewash spray nozzles.
- E4.1.13** Replace outdated laundry equipment with newer models.
- ### **E4.2 Water Conservation**
- E4.2.1** Replace faucets with units that have infrared sensors or automatic shutoff.
- E4.2.2** Install water flow restrictors on shower heads and faucets.
- E4.2.3** Install covers on swimming pools and tanks.
- E4.2.4** Install devices to save hot water by pumping water in the distribution lines back to the water heater so that hot water is not wasted. Install industrial waste/sewage metering.
- E4.2.5** Install water metering.
- E4.2.6** Install landscape irrigation timers to schedule sprinkler use to off-peak, night, or early morning hours when water rates are cheaper and water used is less likely to evaporate.
- E4.2.7** Use low-flow sprinkler heads for landscape irrigation instead of turf sprinklers in areas with plants, trees, and shrubs.
- E4.2.8** Use sprinkler controls for landscape irrigation that employ soil tensiometers or electric moisture sensors to help determine when soil is dry and gage the amount of water needed.
- E4.2.9** Use trickle or subsurface drip systems for landscape irrigation that provide water directly to turf roots, preventing water loss by evaporation and runoff.
- E4.2.10** Install low-flow toilets and waterless urinals
- E4.2.11** Use water reclamation techniques.

E5. ENERGY GENERATION AND DISTRIBUTION

E5.1 Boiler System

- E5.1.1** Install air-atomizing and low NO_x burners for oil-fired boiler.
- E5.1.2** Investigate economics of adding insulation on presently insulated or uninsulated lines. If pipe or duct insulation is missing, replace it with new material. Ensure that the pipe insulation and vapor barrier are maintained or enhanced to ensure thermal performance and avoid water vapor intrusion.
- E5.1.3** Review mechanical standby turbines presently left in the idling mode.
- E5.1.4** Review operation of steam systems used only for occasional services, such as winter-only tracing lines.
- E5.1.5** Review pressure-level requirements of steam-driven mechanical equipment to consider using lower exhaust pressure levels.
- E5.1.6** Survey condensate presently being discharged to waste drains for feasibility of reclaim or heat recovery.
- E5.1.7** Reduce boiler operating pressure to minimize heat losses through leakage.

E5.2 Chiller System

- E5.2.1** Chiller retrofits with equipment that has high efficiency at full and part load.
- E5.2.2** Cooling tower retrofits, including high-efficiency fill, VSD fans, fiberglass fans, hyperbolic stack extensions, fan controls, VSD pump drives, and improved distribution nozzles.
- E5.2.3** Install economizer cooling systems (HX between cooling tower loop and chilled-water loop before the chiller).
- E5.2.4** Install evaporative cooled, evaporative precooled, or water-cooled condensers in place of air-cooled condensers.
- E5.2.5** Isolate offline chillers and cooling towers.
- E5.2.6** Reduce overpumping on chilled-water systems.
- E5.2.7** Replace single compressor with multiple different-size staged compressors.
- E5.2.8** Install two-speed, mechanical unloading, or VFD on compressor motors.
- E5.2.9** Use of absorption chiller when there is cogeneration system, waste heat, or solar thermal available.
- E5.2.10** Install double-bundle chillers for heat recovery.
- E5.2.11** Free cooling cycle by piping chilled water to condenser during cold weather.
- E5.2.12** Prevent chilled water or condenser water flowing through the offline chiller. Chillers can be isolated by turning off pumps and closing valves.
- E5.2.13** For equipment cooling, control makeup water and reduce blowdown by adding temperature control valves to cooling water discharge lines in equipment such as air compressors and refrigeration systems.
- E5.2.14** For evaporative cooling systems, install drift eliminators or repair existing equipment.
- E5.2.15** For evaporative cooling systems, install softeners for makeup water, side-stream filtration (including nanofiltration, a form of low-pressure reverse osmosis), and side stream injection of ozone.

E5.2.16 For evaporative cooling systems, install submeters for makeup water and bleed-off water for equipment such as cooling towers that use large volumes of water.

E5.2.17 Evaporative cooling systems control cooling tower bleed-off based on conductivity by allowing bleed-off within a high and narrow conductivity range. This will achieve high cycles of concentration in the cooling system and reduce water use in cooling towers.

E5.2.18 Clean evaporator and condenser surfaces of fouling.

E5.2.19 Optimize plant controls to raise evaporator temperature as high as possible while meeting system loads. Also optimize condenser water temperature control to achieve best combination of chiller and tower efficiency.

E5.2.20 Optimize multiple chiller sequencing.

E5.2.21 Control crankcase heaters off when they're not needed.

E5.2.22 Raise evaporator or lower condenser water temperature.

E5.2.23 Optimize multiple chiller sequencing.

E5.2.24 Use two-speed or variable-speed fans instead of water bypass to modulate the cooling tower capacity.

E5.2.25 Balance water flow in the chilled-water system.

E5.2.26 Use VFDs for the primary chilled-water pumps above 5 hp (3.7 kW). Consult chiller and tower manufacturers' specifications to set appropriate minimum flow limits.

E5.2.27 Apply cooling load-based optimization strategies.

E5.2.28 Install water-source heat pumps (WSHPs) to augment the capacity of the hot-water boiler and to reduce the cooling load on the existing chiller systems when heat is required.

E5.2.29 Trim impellers on all condenser water and chilled-water pumps that are oversized.

E5.2.30 Replace all pump and fan motors with premium efficiency motors.

E5.3 Thermal Storage and Heat Pumps

E5.3.1 Install cool storage to reduce peak demand and lower electric bills.

E5.3.2 Install hot-water storage to shave peaks of hot-water use or to store reclaimed energy from combined heat and power systems or waste heat from chillers for later use.

E5.3.3 Install add-on heat pumps.

E5.3.4 Install secondary pumping systems.

E5.3.5 Install VFDs on secondary pumps and replace most three-way valves with two-way valves.

E5.3.6 With cool storage and VFDs on fans and pumps, consider use of low-temperature chilled water to reduce fan and pump energy.

E5.3.7 Replace electrically powered air conditioning and heating units with heat pumps. Consider geothermal or ground-source heat pumps.

E5.3.8 Replace electric water heaters with electric heat-pump water heaters.

E5.4 Electric and Heat Cogeneration

E5.4.1 The application of cogeneration should be considered where use of both electrical and thermal energy can be achieved on a cost-effective basis.

E5.4.2 Subject to *AHJ* approval, where combined heat and power (CHP) plants are installed as energy efficiency improvements, the energy audit and analysis of overall *building* energy use performance may follow the Federal Energy Management Program (FEMP) guidelines, *Reporting Guidance for Federal Agency Annual Report on Energy Management* (per 42 U.S.C. 8258) Attachment 3. Energy efficiency projects may be allowed to receive a credit in the amount of the annual *source energy* savings from CHP, which would be used to offset the *building site energy* used in calculating and comparing against the *EUI* targets.

E6. NONRESIDENTIAL LIGHTING

In implementing any of these *EEMs*, care should be taken to not compromise the photometric distribution or any required light levels.

E6.1 General. Check the current IES recommended light levels for the tasks in the facility. They may be lower than when the original lighting system was designed. Use these current recommended light levels to help shape all future lighting decisions, including those enumerated here.

E6.2 Daylighting

E6.2.1 In any spaces with fenestration, evaluate opportunities for *daylight harvesting* by determining the spatial daylight autonomy (sDA) in accordance with IES LM-83. In spaces where $sDA_{300,50\%}$ is greater than 55%, consider installing daylight switching or daylight dimming controls (and appropriate ballasts if the lighting system is fluorescent or high-intensity discharge [HID]) to reduce use of electric lighting.

E6.2.2 In any spaces with fenestration, evaluate the need for shading by determining the annual sunlight exposure (ASE) in accordance with IES LM-83. In spaces where $ASE_{1000,250}$ is greater than 10%, interior and/or exterior shading should be installed to reduce solar heat gain and cut down on heat loss and control the amount of light entering the space from the exterior.

E6.2.3 Install a skylight, tubular daylighting device, or sunlight delivery system to reduce the use of electric lighting and provide natural daylight to the internal spaces of the *building*.

E6.3 Luminaire Upgrades

E6.3.1 Upgrade incandescent *lamps* in existing *luminaires* with more effective sources, such as halogen, integrally ballasted compact fluorescent, solid state (LED), or metal halide retrofit *lamps*. Alternatively, replace incandescent *luminaires* with *luminaires* using these sources.

E6.3.2 Upgrade T12 fluorescent *luminaires* with more effective sources, such as high-performance T8 or T5 systems, by replacing *lamps* and ballasts, using *luminaire* upgrade kits, or installing new *luminaires*.

E6.3.3 If the lighting system is already a high-performance fluorescent system, consider replacing the *lamps* with reduced-wattage *lamps* (where appropriate).

E6.3.4 For fluorescent lighting, install high-performance electronic ballasts that are multilevel or continuously dimmable with the appropriate controls.

E6.3.5 Replace mercury vapor or probe-start metal halide HID *luminaires* with pulse-start metal halide or high-performance T8 or T5 fluorescent *luminaires*.

E6.3.6 Upgrade task and display lighting, including lighting in refrigeration and freezer cases, to more effective sources such as LED.

E6.4 Signage

E6.4.1 Evaluate upgrading standard fluorescent or neon signage with more effective sources, such as high-performance T8 or T5 fluorescent systems or solid-state (LED) systems.

E6.4.2 Upgrade all exit signs to solid state (LED). Supplemental lighting may need to be added if the existing exit sign also provides general lighting.

E6.5 Lighting Controls

E6.5.1 Reduce lighting use through management and controlled systems. In general, consider bringing the lighting control protocols for the *building* up to ASHRAE/IES Standard 90.1-2010 (Section 9.4.1) standards; this includes the following.

E6.5.2 Reduce operating hours for lighting systems through the use of controls and *building* management systems. This includes the use of shut-off controls, such as time switches.

E6.5.3 Use reduced lighting levels, including off, when spaces are unoccupied, during *nighttime hours*, and for restocking, cleaning, and security. Whenever possible move restocking and cleaning operations to normal operating hours.

E6.5.4 Use occupancy, vacancy, or *motion sensors*. Whenever applicable, these sensors should either be manual-on or turn lighting on to no more than 50% of *lighting power*.

E6.5.5 Use controls to provide multiple light levels or dimming where appropriate.

E6.5.6 Recircuit or rezone lighting to allow personnel to only turn on *zones* based on use rather than operating the entire lighting system.

E6.5.7 Install personal lighting controls so individual occupants can vary the light levels within their spaces.

E6.5.8 Consider installation of lighting systems that facilitate load shed requests from the electric utility or energy aggregator.

E6.5.9 Evaluate turning emergency lighting off or to a lower level when a *building* or portion of a *building* is completely unoccupied, without sacrificing safety requirements.

E6.6 Exterior Lighting

E6.6.1 Use automatic controls that can reduce outdoor lighting levels or turn lights off when either sufficient daylight is available or when lighting is not needed. All facade and landscape lighting should be off from an hour after closing until an hour before opening. All other lighting should be reduced by at least 30% during that same time frame or when a *motion sensor* detects no activity for 15 minutes. These controls are not appli-

cable to lighting for covered vehicle entrances or exits from *buildings* or parking structures where required for safety, security, or eye adaptation.

E6.6.2 Reduce power levels or turn exterior signage off when appropriate.

E6.6.2.1 Signs that are meant to be on for some part of *daylight hours* should be reduced in power by at least 65% during *nighttime hours*. All other sign lighting should automatically turn off during *daylight hours* and reduced in power by at least 30% from an hour after closing until an hour before opening. These controls are not applicable to sign lighting using metal halide, high-pressure sodium, induction, cold cathode, or neon *lamps* that are automatically reduced by at least 30% during *nighttime hours*.

E6.6.3 When selecting new outdoor *luminaires*, consider the amount of backlight, upright, and glare delivered by each *luminaire* type to improve functionality and minimize environmental impacts. See ASHRAE/USGBC/IES Standard 189.1-2011, Section 5.3.3.

E6.7 Luminaire Layout

E6.7.1 Consider using lower levels of general illumination overall and then supplement with task lighting where needed.

E6.7.2 Consider new layouts that may maximize efficiency and reduce the total connected lighting load. Consider plug-and-play systems to provide flexibility as space use changes.

E6.8 Other

E6.8.1 Implement a plan to recycle *lamps*, ballasts, and *luminaires* removed from the *building*.

E6.8.2 Consider updating lighting systems to provide for demand response capability so that lighting loads are reduced during periods of peak electricity demand. These types of systems can provide day-to-day energy savings in addition to demand response capability.

E7. RESIDENTIAL LIGHTING

E7.1 General

E7.1.1 Replace incandescent *lamps* with halogen, integrally ballasted compact fluorescent, or solid-state (LED) retrofit *lamps* in existing *luminaires*.

E7.1.2 Color temperature indicates the color appearance of the light produced by the *lamp*. Halogen *lamps* are a more energy-efficient form of incandescent technology and will deliver light similar to incandescent *lamps*. Linear fluorescent, compact fluorescent, and solid-state (LED) *lamps* are available in a variety of color temperatures. *Lamps* with color temperatures of 2700 K and 3000 K will deliver the most incandescent-like light. *Lamps* with a color temperature of 3500 K deliver a neutral, white light. *Lamps* with color temperatures of 4000 K and higher will deliver cooler, white light; the higher the color temperature number, the cooler the light.

E7.1.3 Select *lamps* appropriate for use in enclosed *luminaires*, outdoor applications, and cold temperature applications, and for use with dimming controls. Check the packaging or manufacturer's website for guidance.

E7.1.4 Use energy-efficient technologies such as fluorescent, compact fluorescent, or solid state (LED) in applications with the longest operating times.

E7.1.5 Use a whole-home lighting control system that provides energy-saving features, such as dimming, occupancy sensing, and *daylight harvesting*, and allows occupants to turn all the lights off from a single location or remotely.

E7.2 Interior

E7.2.1 Replace on/off switches with dimming controls, vacancy sensors, or countdown timers. Use dimming controls, vacancy sensors, or countdown timers for lights or fans in bathrooms. Use vacancy sensors in garages, laundry rooms, closets, and utility rooms.

E7.2.2 By replacing *lamps* and ballasts or installing new *luminaires*. Ballasts should be FCC rated for residential use.

E7.2.3 Evaluate replacing incandescent and halogen *luminaires* with dedicated compact fluorescent or solid-state (LED) *luminaires*.

E7.2.4 When replacing fluorescent ballasts or installing new fluorescent *luminaires*, evaluate using electronic dimming ballasts with the appropriate dimming controls.

E7.2.5 Evaluate adding daylight-sensing controls for general illumination lighting in rooms with windows or skylights. Use in combination with dimming systems so that the electric light level can be adjusted based on the amount of daylight available.

E7.2.6 Install vacancy sensors to automatically turn off lighting in closets, storage, work rooms, garages, and exterior *buildings* when the space has been vacated for 15 minutes.

E7.2.7 Add task lighting that uses energy-efficient technologies, such as fluorescent and solid state (LED), and reduce or eliminate overhead lighting.

E7.3 Exterior

E7.3.1 Install time switches and/or *motion sensors* to control outdoor lighting.

E8. ELECTRIC SYSTEMS, MOTORS

E8.1 Install energy-efficient transformers. Use infrared cameras to identify high-heat-loss transformers.

E8.2 Install electrical meters for submetering lighting, elevators, plug loads, and HVAC equipment.

E8.3 Reduce demand charges through load shedding, operational changes, and procedural changes.

E8.4 Replace oversized electric motors with right-sized or slightly oversized motors.

E8.5 Replace existing three-phase, 1 hp (746 W) and greater electric motors with premium-efficiency motors (often a better choice than rewinding motors).

E8.6 Replace existing one-phase, 1 hp (746 W) and less motors with electrically commutated motors.

E9. APPLIANCES

E9.1 Install appliances (clothes washers, dehumidifiers, dishwashers, freezers, refrigerators, room air cleaners and purifiers, office equipment, and televisions) that are certified as ENERGY STAR® compliant.

E9.2 Reduce plug loads, using devices to shut off equipment not being used (use *occupancy sensors* or timers).

E9.3 Install vending-machine controllers.

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INFORMATIVE ANNEX F

Informative Annex F Standard 100 Compliance Flow Chart - Not adopted.

(This annex 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 objections on informative material are not offered the right to appeal at ASHRAE or ANSI.)

INFORMATIVE ANNEX G CLIMATE ZONES

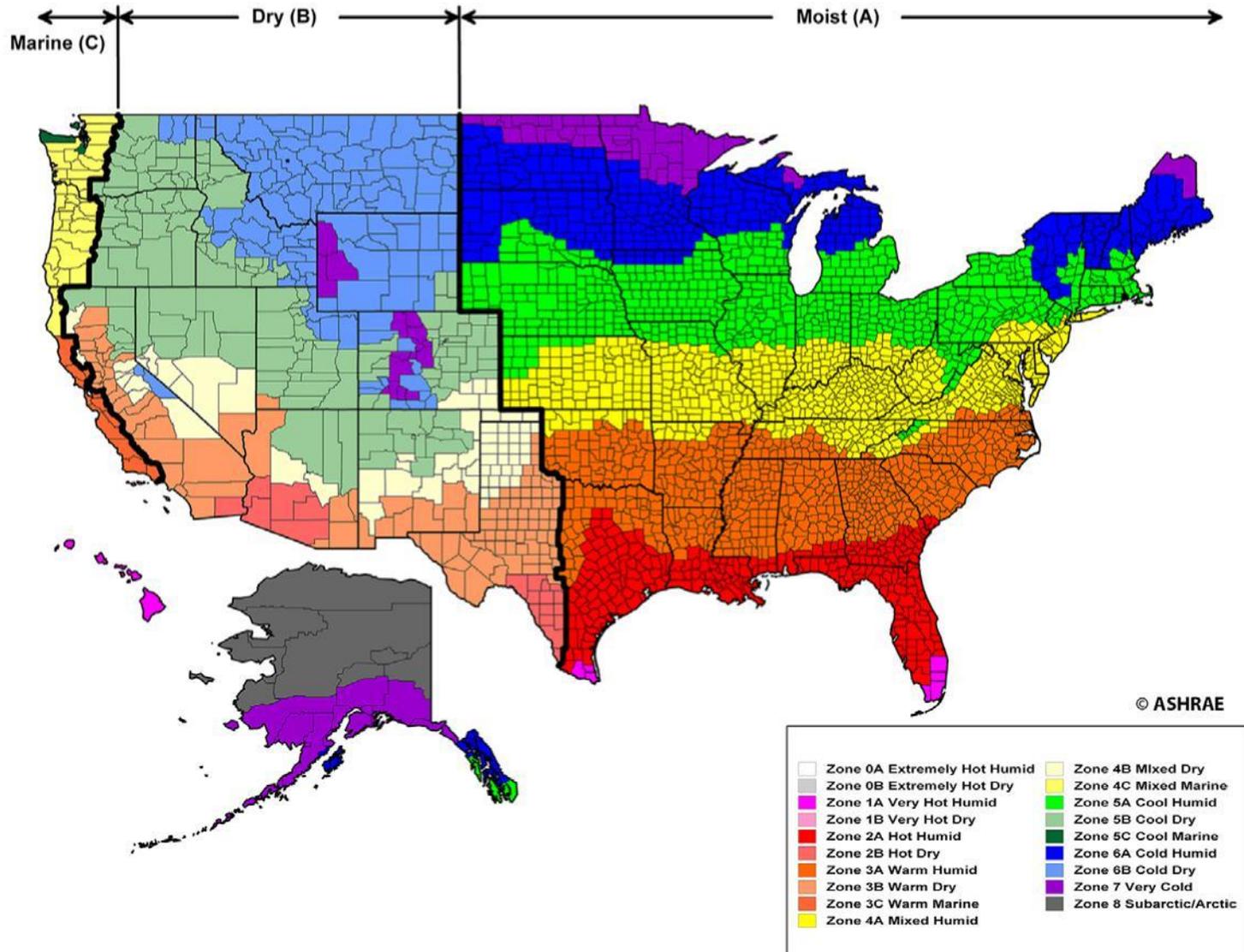


Figure G-1 U.S. climate zone map.

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INFORMATIVE ANNEX H SIMPLE PAYBACK AND LIFE-CYCLE COST ANALYSIS

H1. SIMPLE PAYBACK AND LIFE-CYCLE COST ANALYSIS

H1.1 General. For small *buildings* and efficiency improvement measures with a payback period of fewer than five years, *simple payback* is probably adequate to make decisions. For federal *buildings* and for larger *buildings* or *buildings* with longer payback periods, more sophisticated financial analyses are advisable.

Life-cycle costing (LCC) is used to evaluate the total cost of ownership of *energy efficiency measures (EEMs)*. LCC accounts for factors such as the time value of money, escalation of *energy costs* over time, annual maintenance costs,

component replacement costs, and the useful life of the equipment. Other factors that may also be considered include temporary disruption of *building* operations.

H1.2 Simple Payback. *Simple payback* can best be described by the following equation:

$$\text{Simple payback} = \frac{\text{Total project cost}}{\text{Annual changes in cash flow}}$$

Annual changes in cash flow typically reflect the energy savings resulting from the *EEMs* under consideration.

H1.3 Life-Cycle Cost Analysis. The evaluation tool that yields the most comprehensive analysis is called *life-cycle cost analysis*, which takes all capital, energy, and operating costs into account over the useful life of a facility or *EEM*. Life-cycle cost analysis provides a means to establish the worth of a particular project and is generally required to appropriately allocate limited funding. In line with typical capital investment considerations, the present value of future benefit of investment should be greater than the initial cost.

Life-cycle cost analysis should follow the National Institute of Standards and Technology (NIST) *Life-Cycle Costing Manual* or the Building Life-Cycle Cost (BLCC) computer program. Both can be accessed from the Federal Energy Management Program (FEMP) website.

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INFORMATIVE ANNEX I BUILDING ENERGY MODELING

11. BUILDING ENERGY MODELING

11.1 General. For larger, more complex *buildings*, computerized energy modeling can be a valuable tool in simulating the annual energy use of a *building* and in analyzing alternative *energy efficiency measures (EEMs)* or for optimizing energy efficiency bundles. The tool can also help prioritize investment strategies and identify the most cost-effective measures.

Data from the existing *building* can be used to develop the *baseline reference building* model, and that model should be validated against current annual utility costs. The validated model can then be modified to reflect proposed *EEMs*, either individually or collectively, in order to create the proposed *building* model.

Unless specifically impacted by the proposed *EEMs*, the proposed *building* model should be identical to the reference *building* model for all elements, including *building* classification, location, utility rate structure, annual weather data, design-day weather data, internal design conditions—summer and winter, form, shape, orientation, envelope, infiltration, interior lighting, *HVAC systems*, ventilation requirements, receptacle load, process loads, occupancy, and operating schedules.

The models can be documented by reports generated by the modeling software or by manually completing the compliance forms from the Standard 90.1 User’s Manual or

equivalent forms. Simulation software varies in sophistication and detail, from the quick view programs such as eQUEST (DOE-2), EnergyPlus, or manufacturers’ software, such as HAP or Trace. End-use specific tools are available for pumping systems from the DOE’s Advance Manufacturing Office. The Standard 90.1 User’s Manual compliance forms can be downloaded from ASHRAE’s website.

Utility rate structures and tariffs are published by the Energy Information Agency or can be obtained from your local utilities and energy suppliers.

The energy simulations of the reference *building* and the proposed *building* models must use the same annual hourly weather file, and that file must represent a typical weather year for the current *building* location. The weather file should be selected from the climate zone that most closely represents the typical weather conditions at that location. Many simulation programs provide specially formatted versions of the TMY2 or other similar weather files for use with their programs.

ASHRAE/IES Standard 90.1 (versions 2004, 2007, and 2010) provides background modeling and simulation guidance in Appendix G, “Performance Rating Method.”

Energy models should be developed by qualified professionals and meet the minimum eligibility requirements under the ASHRAE Building Energy Modeling Professional (BEMP) certification program.

The design-day weather data used for sizing equipment shall represent 99.6% annual cumulative frequency dry-bulb temperature for heating conditions and the 1% annual cumulative frequency dry-bulb and wet-bulb temperatures for cooling conditions. Table I-1 lists sources of design-day weather data.

REFERENCES

- ASHRAE. 2005. *ASHRAE Handbook—Fundamentals*. Atlanta: ASHRAE.
- ASHRAE. 2006. ANSI/ASHRAE Standard 169, *Climatic Data for Building Design Standards*. Atlanta: ASHRAE.

Table I-1 Annual Weather File Sources

Weather File	Source
TMY2—Typical Meteorological Year 2	http://www.rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3
CTZ2—California Climate Zone 2	http://www.energy.ca.gov/title24/index.html

Table I-2 Design-Day Weather Data Sources

Weather File	Source
ANSI/ASHRAE Standard 169	(ASHRAE 2006)
<i>ASHRAE Handbook—Fundamentals</i>	(ASHRAE 2005)

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INFORMATIVE ANNEX J
DERIVATION OF ENERGY INTENSITY TARGETS
FOR STANDARD 100 - Not adopted

INFORMATIVE ANNEX K
FUEL HEAT CONTENT CONVERSION VALUES—
“OTHER” FUELS - Not adopted

(This is a normative annex and is part of this standard.)

NORMATIVE ANNEX L OPERATIONS AND MAINTENANCE IMPLEMENTATION

Informative Note: This annex is based on Section 4 of ANSI/ASHRAE/ACCA Standard 180-2012, *Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems*, with application to the operations and maintenance (O&M) of all *building* systems.

L1. RESPONSIBLE PARTY

The *building owner* shall be responsible for meeting the requirements of this standard. The owner may designate other parties that shall be authorized and contractually obligated to fulfill the owner's responsibility.

L2. OPERATIONS AND MAINTENANCE PROGRAM

Each building system shall have an O&M program that, at a minimum, preserves the condition of the system and its elements in a manner that enables the system to provide the intended thermal and visual comfort, energy efficiency, and helps to achieve the intended indoor environmental quality required for the building.

At a minimum, the O&M program shall contain an inventory of equipment, systems and controls to be inspected and maintained and a maintenance plan describing the goals, objectives, and execution of the systems maintenance program.

L2.1 Inventory of Items to be Inspected and Maintained. Components of *building* systems that impact the *building's* performance shall be inventoried. This detailed list shall be used to establish unacceptable system condition indicators, inspection frequencies, and maintenance tasks.

L2.2 Maintenance Plan Development. For any given facility, the maintenance plan shall be written and developed specifically to meet the size, design, scope, and complexity of the systems serving that facility. The plan shall describe required tasks, identify the party responsible for performing these tasks, specify the authorizing party, document completion of required tasks, and subsequently monitor the results. The plan shall include all of the following information.

L2.2.1 Performance Objectives. Performance objectives shall incorporate thermal and visual comfort, energy efficiency, and indoor environmental quality metrics. Performance objectives shall be based on design intent and operational criteria specific to a particular system. The source of the performance objectives shall be documented.

L2.2.2 Condition Indicators. Indicators of unacceptable system and equipment conditions shall be established. These indicators are measurements or observations of conditions that could lead to failure or performance degradation.

L2.2.3 Inspection and Maintenance Tasks. Inspection and maintenance tasks for inventoried equipment, systems and controls shall be established. Inspection shall include the physical assessment of system components and may include measurement of operating parameters and data provided by

sensors or a building management system (BMS). Maintenance tasks shall include adjustment, service, or replacement of inventoried equipment and systems. Control systems settings including, but not limited to, set points, schedules and sequence of operations shall be inspected and maintained.

L2.2.4 Inspection and Maintenance Task Frequencies. Frequency of inspection and maintenance tasks for inventoried equipment, systems and controls shall be established. If unacceptable condition indicators or unacceptable performance is found during two successive inspections, the owner or owner's designated representative shall investigate and analyze possible causes. At a minimum, the following possible causes shall be investigated:

- Poor field practices. Review inspection documentation and/or technician execution to ensure maintenance tasks are performed correctly.
- Insufficient time budgeted for tasks. Review time budgeted to the technician to ensure that reasonable time has been given to perform the tasks.
- Component repairs noted/pending/not made. Inspect documentation to determine that repair or component replacement has been undertaken.
- Design issues. Determine whether underlying design issues are causing successive failures
- Obsolete equipment or components. Determine whether the equipment or component has been in service beyond its useful life.
- Conditions outside of the building system causing failure. Investigate whether water leaks, vandalism, a problem in the building envelope, a problem with the power supplied to the building, or some other external factor is causing the problem.

Based on the analysis, the inspection frequency or the maintenance task shall be modified to resolve the deficiency.

If acceptable condition indicators or acceptable performance is found during three successive inspections, the inspection frequency for that task may be reduced from the existing frequency. The reduced frequency shall be based on the specific findings and shall be documented.

Frequency may be adjusted for climate related or operational reasons. Each adjusted frequency shall be documented, including the reason for the adjustment.

Informative Note: Examples include the following:

- **Cooling tower shutdown during the winter.** Inspection and maintenance may be suspended during the shutdown period.
- **A new chiller is installed and the old chiller is retained as a backup.** Inspection and maintenance of the backup unit may be adjusted to reflect fewer operating hours.
- **A new lighting fixture and lamp is installed with a much longer life expectancy.** Inspection and *lamp* replacement frequency may be extended to reflect the new device.

L2.2.5 Documentation. A minimum inspection and maintenance documentation package shall consist of the following items:

1. Listings of *building* systems and system components with associated performance criteria pertinent to the facility
2. Inspection and maintenance tasks and the method of tracking (automated or manual).
3. Identify building systems or components operating beyond their useful life.
4. Sufficient record detail and verification (written or electronic) to demonstrate implementation of the maintenance plan.

The inspection and maintenance document directory shall provide easy access and be well organized and clearly identified. Emergency information shall be immediately available and shall include emergency staff and/or agency notification procedures.

L2.3 Maintenance Plan Authorization and Execution. Inspection and maintenance tasks shall be performed on an established frequency or upon a documented observance of unacceptable condition. Whether authorized by written or

verbal instructions, execution of the task shall be documented and archived for future reference.

L2.4 Revision of the Maintenance Program. The O&M program shall be reviewed, and revision considered, in any of the following situations:

- a. Modifications to the *building* that impact *building* system performance objectives have occurred.
- b. The *building* function or its use has changed in a way that impacts *building* system performance objectives.
- c. *Building* system component changes have occurred.
- d. One or more systems are found to be incapable of achieving their performance objectives.
- e. Upon documented recommendation from the maintenance provider.

Informative Annex M Guidance on Building Type Definitions - Not adopted.

Informative Annex N Addenda Description Information - Not adopted

Normative Annex X—Investment criteria.

X1 Demonstrating compliance with the investment criteria. Buildings seeking compliance using the exception to Section 9.1.1.1 or 9.1.1.2 shall demonstrate compliance with the financial investment criteria of this annex. The investment criteria shall be documented using level 2 energy audit and by performing the life cycle cost analysis (LCCA) as per X2.2.

X1.1 General guidance on cost and benefits for the base case and alternative case.

The life cycle cost analysis is a process which compares the base case of the existing building to the alternative case that implements EEMs proposed by the energy audit. Total life cycle cost of each case are produced by the analysis, but the resulting cost and benefits of interest are the incremental life cycle cost difference between each case. Measures and bundles of measures demonstrating positive life cycle cost compared to the base case are to be implemented in accordance with chapter 9.

The base case will include all costs for energy, operations and maintenance and other related costs scheduled in the analysis period. This may include replacement of existing equipment upon failure with code compliant equipment. All these costs are captured in the base case.

The alternate case captures all cost and benefits associated with implementing additional efficiency features. All cost and all benefits of implementing EEMs required by Section 9 should be captured by the analysis. All documented costs may be considered.

Extended implementation periods are allowed by this standard. This allows more EEMs to be considered at time of failure resulting in much of the cost of implementation being attributed to the base case. This requires including the implementation timing of the measure in the extended compliance period. Ultimately, this reduces the cost of the alternative case and will likely make EEMs that are not cost effective as an early replacement be cost effective as replacement upgrade.

X2 Energy audits and investment criteria pathway.

X2.1 Buildings qualifying under the investment criteria must complete a LCCA and implement an optimized bundle of energy efficiency measures that provide maximum energy savings without resulting in a savings-to-investment ratio of less than one.

Exception: Building owners may demonstrate compliance with this section by completing the Level 2 energy audit and implementing all EEMs determined to have a simple payback that is less than the EEMs expected useful life.

X2.2 The procedures for developing the investment criteria shall be based on ANSI/ASHRAE/ACCA Standard 211 Section 5.5.2 and Section 5.5.3 Life-Cycle Cost Analysis (LCCA) as modified by section X2. The LCCA shall also follow, and consider the findings of, the Level 2 Audit as defined by ANSI/ASHRAE/ACCA Standard 211 Section 5.4.

X2.3 Investment criteria chronological process.

X2.3.1 Level 2 audit. Evaluate a comprehensive list of individual EEMs using simple payback as a screening criteria. Individual EEMs determined to have a simple payback that is less than the EEMs useful life may be excluded from further consideration.

X2.3.2 Life cycle cost assessment. Identify an optimized bundle of EEMs that provides maximum energy savings without resulting in a savings-to-investment ratio of less than one. The optimized bundle of measures shall be implemented based on the schedule established within the energy management plan.

X2.3.2.1 Life cycle cost assessment on individual measures. Individual measures that do not meet the life cycle cost test may be excluded from the implementation plan if they are not integral to the implementation of other cost effective measures in the bundle.

X2.3.2.1 Phased implementation. The LCCA and energy management plan may include phased implementation such that the building owner is not required to replace a system or equipment before the end of the system or equipment's useful life.

X3 Included LCCA costs and savings.

X3.1 The costs and savings to be included within the life cycle cost analysis shall be based on ANSI/ASHRAE/ACCA Standard 211 Sections 5.4.8.1, 5.5.2 and 5.5.3 as modified by the following:

X3.1.1 Cost for implementation of EEM, as required by Section 9.
Estimate EEM Costs (based on Standard 211 Sections 5.4.8).

Estimate the total expected cost of implementation for each practical measure. Cost estimates shall include the following factors, as applicable:

1. Material costs
2. Labor costs, contracted or executed by employees
3. Design fees
4. Construction management, contracted or executed by employees
5. Site-specific installation factors
6. Permits
7. Temporary services
8. Testing, adjusting, and balancing
9. Utility service upgrades
10. Verification, as required in section 9.2.2 only.
11. Commissioning
12. Taxes
13. Profit
14. Any additional adjustments that significantly impact the cost estimate of the EEM.

Informative Note: Multiple measures affecting the same building systems or end uses may be combined and their costs estimated as a group. Combining costs may improve the cost effectiveness of combined measures.

Hazardous material abatement (based on standard 211, 5.4.8.2). Estimation of hazardous material abatement costs is not required. If the possible presence of hazardous materials is apparent at the site, either through observation or as reported by others, the possible presence of the hazardous material shall be included in the report (see Standard 211 Section 6.2.5) as potentially affecting health and safety and installation costs.

Cost and cost savings of recommended EEMs (based on standard 211 section 5.5.2).

Estimate the initial and recurring costs, energy cost savings, and nonenergy cost savings of each measure and each integrated group of measures. Cost estimates shall either be:

1. Obtained from a vendor at the quoted price; or
 2. Based on quotations of similar projects within the last year;
- or
3. Based on labor cost estimates for employee labor.

Life-cycle cost analysis (LCCA) (based on standard 211 section 5.5.2). LCCA 7,8,9,10 of each recommended EEM shall be conducted for a time frame that spans, at a minimum, the life of the measure with the longest service useful life and shall include the following:

1. Initial costs (per Standard 211 Section 5.4.8.1);
2. Financing costs;
3. Annual energy costs;
4. Escalation rates as published by the AHJ. citing the source within the energy audit report;
5. Discount rates as published by the AHJ citing the source within the energy audit report;
6. Tax credits and deductions;
7. Cash incentives, grants, and rebates;
8. Expected periodic replacements;
9. Estimated recurring nonenergy costs (maintenance, etc.), of each measure or set of measures. Such costs include annual maintenance and service labor costs, routine replacement of worn parts, or annual warranty fees from manufacturers;
10. Contingency funds not to exceed 5% of estimated EEM implementation cost; and
11. Water & sewer savings from EEM. EEMs that provide water and/or wastewater savings shall include the operations and maintenance savings resulting from implementation of the EEM.

X4 Life cycle cost analysis methodology, form and key variables.

X4.1 Life-cycle cost analysis completed for buildings qualifying under the investment Criteria shall follow the National Institute of Standards and Technology (NIST) Life-Cycle Costing Manual Handbook 135 except as specified in this standard in Table X4.

Table X4 Life Cycle Cost Analysis Variables Independent of NIST

Handbook - 135 Methodology.

Public owner discount rate	A fixed annual rate based on the cost of borrowing through the Washington state treasurer, certificate of participation programs, the local program and the state lease-purchase program.
Private owner discount rate	Shall be the published <i>Wall Street Journal Prime Rate</i> for based on the average of the previous twelve months.
Financing	Applicants with documented costs of borrowing assuming one hundred percent of the EEM implementation costs are financed at an actual cost of borrowing and stated terms when the property being improved is listed as loan collateral.
Rate of inflation	A fixed annual rate, as published annually by the Washington state office of financial management.
Fuel escalation rate	Based on the most recent edition of <i>NIST Handbook – 135 Annual Supplement - Fuel Escalation Rates</i> .
Study period	Equal to the useful life of the longest-lived EEM within an optimized bundle. (STD 211, 5.5.3)

X4.2 Publication of analysis variables. The AHJ shall update the contents of Table X4 on an annual basis and incorporate the results in updates to the Normative Annex X - Investment Criteria form specified in Normative Annex Z.

Normative Annex Z— Washington state reporting requirements. Z1 Building owner notifications by the AHJ and building owner response.

Z1.1 Notification to building owners of covered commercial buildings by the AHJ. Based on records obtained from each county assessor and other available information sources, the AHJ must create a database of covered commercial buildings and building owners required to comply with the standard established in accordance with this section. The database may include buildings and building complexes presumed to meet the definition of covered commercial building and multifamily buildings greater than 50,000 square feet in floor area.

Z1.1.1 The database will contain information about buildings that may be subject to compliance, their owners, and information about multifamily residential buildings eligible for incentives. The database may also contain information to assist tracking and reporting on building owner compliance, and incentive application and distribution. Commerce will create a method for tracking building owner notification responses. Each building or building complex will be assigned a unique building identifier.

Z1.2 By July 1, 2021, the AHJ must provide the owners of covered commercial buildings with notification of compliance requirements. Notifications will be mailed to the mailing addresses county assessors have on file.

Z1.3 Failure by the AHJ to provide the notification in Z1.2 does not release the building owner of the legal obligation to comply with this law.

Z1.4 By July 1, 2021, the AHJ must provide notifications to the building owners of multifamily residential building where the floor area exceeds fifty thousand gross square feet, excluding the parking garage area.

Z2 Building owner response to notifications.

Z2.1 Correction of errors. Building owners are responsible for reviewing the property and building information provided by the AHJ through notification including, but not limited to, building or building complex ownership details, gross floor area, and other information as identified by the building owner.

Z2.1.1 Correction of errors documentation form. Building owners who are notified in error may submit a correction form to the AHJ. The correction form will be used to document gross floor area (conditioned and unconditioned) and/or building type. Building owners that submit the correction form must also submit the documentation required to demonstrate an exception as required in section Z4.1 prior to the compliance date if applicable.

Washington State Reporting Requirements for Building Owners.

Z3 General Compliance. The building owner of a covered commercial building must report compliance with the standard to the AHJ in accordance with the schedule established under Section Z3.1 and every five years thereafter. For each reporting date, the building owner must submit documentation to demonstrate that:

1. The weather normalized energy use intensity of the covered commercial building measured in a period not to exceed two years prior to the reporting deadline specified in Normative Annex Z3.1 is less than or equal to the energy use intensity target (buildings that meet their energy targets); or
2. The *covered commercial building* has received conditional compliance from the department based on energy efficiency actions prescribed by the standard; or
3. The *covered commercial building* is exempt from the standard by demonstrating that the building meets one of the criteria for an exemption.

Z3.1 Compliance schedule. The building owner of a covered commercial building must report the building owner's compliance with the standard to the department in accordance with the appropriate initial compliance date as follows and every five years thereafter.

1. For a building with more than two hundred twenty thousand gross square feet, June 1, 2026;
2. For a building with more than ninety thousand gross square feet but less than two hundred twenty thousand and one gross square feet, June 1, 2027; and
3. For a building with more than fifty thousand gross square feet but less than ninety thousand and one square feet, June 1, 2028.

Z3.1.2 Application for conditional compliance. Applications for conditional compliance must be submitted to the AHJ one hundred eighty days prior to the compliance date to receive conditional compliance approval prior to the compliance date.

Z3.1.3 Application for exemption. Building owners submitting an application for exemption as specified in section Z4.1 must be submitted to the AHJ one hundred eighty days prior to the compliance date to receive exemption approval prior to the compliance date.

Z4 Documentation of compliance with the standard. Documentation of compliance shall be submitted to the AHJ demonstrating the building owner has complied with the standard through submission of documentation in accordance with section Z4.1, Z4.2, Z4.3, Z4.4 or Z4.5. Additional requirements for continued reporting may be required as specified in Z4.6.

Z4.1 Documentation of compliance through exemption. Building owners seeking approval of exemption shall submit to the AHJ the Z6.7 Form H, Application for exemption certificate documenting the following:

1. The building qualifies for one of the following exemptions:
 - a. Compliance with the exemption must be verified by the owner based on the building as it is to be occupied and operating on the compliance date.
 - b. Applications for exemptions may be submitted no sooner than 1 year prior to the compliance date and submitted to the AHJ no later than one hundred eighty days prior to the compliance date.
 - c. Exemptions certificates are only valid for the current compliance review cycle.
2. Covered commercial buildings are not eligible for exemption from the standards unless they meet one of the following criteria:
 - a. The building did not have a certificate of occupancy or temporary certificate of occupancy for a consecutive twelve months period within two years prior to the compliance date.
 - b. The building did not have physical occupancy by owner or tenant for at least fifty percent of the *conditioned floor area* throughout the consecutive twelve month period prior to the building compliance date.
 - c. The sum of the *building's gross floor area* minus *unconditioned* and *semi-conditioned spaces*, as defined in the Washington State Energy Code, is less than fifty thousand square feet;

- d. More than 50% of the gross floor area of the building is primarily used for manufacturing or other industrial purposes, as defined under the following use designations of the Washington state edition of the International Building Code:
 - i. Factory group F; or
 - ii. High hazard group H.
 - e. The building is an agricultural structure;
 - f. The building is vacant due to renovation or pending demolition; or
 - g. The building meets at least one of the following conditions of financial hardship:
 - i. The building had arrears of property taxes or water or wastewater charges that resulted in the building's inclusion, within the prior two years, on a city's or county's annual tax lien sale list;
 - ii. The building has a court appointed receiver in control of the asset due to financial distress;
 - iii. The building is owned by a financial institution through default by a borrower;
 - iv. The building has been acquired by a deed in lieu of foreclosure within the previous twenty-four months;
 - v. The building has a senior mortgage subject to a notice of default;
 - vi. The building owner has an immediate and heavy financial need which cannot be satisfied from other reasonable available resources and which are caused by events that are beyond their control.
 - h. The building is a *more recently built buildings* that obtained an original occupancy permit no more than three years prior to the initial compliance date specified in Z3.1.
3. After documents have been submitted and reviewed, the AHJ will send notification of approval or denial.
 - a. If the exemption is approved the AHJ shall notify the applicant stating the application has been approved and update the AHJ records for the building.
 - b. If the exemption is denied the AHJ shall notify the applicant stating the application has been denied and update the AHJ records for the building.
 4. When an application for exemption is denied the building owner must proceed with the process to demonstrate compliance with one of the compliance options in Washington state reporting requirements for building owners, Z4.2-Z4.5.

Z4.2 Buildings that meet the EUI_t. Building owners must provide the following documentation to verify that the building weather normalized EUI is less than the building EUI_t and that the energy management plan is complete and being implemented.

- Form A
- Form B
- Form C

Z4.3 Buildings that will meet the building investment criteria prior to the compliance date. Building owners must provide the following documentation to verify that the building has implemented all EEMs that meet the cost effectiveness criteria resulting from the energy audit and economic evaluation criteria from Normative Annex X. The energy management plan must be completed and implemented and all EEMs must be installed and commissioned prior to the compliance date.

- Form A
- Form B
- Form C, except buildings unable to meet Section 5.2, Building energy monitoring.
- Energy audit report.
 - Level 2 Energy audit
 - Normative Annex X – Investment Criteria Form.

Z4.4 Buildings that will meet the EUI_t through conditional compliance. *Building owners* must provide the following documentation to verify that the building *weather normalized* EUI is projected to be less than the building EUI_t at the end of the measurement and verification period and that the energy management plan is complete and being implemented. EEMs required to meet the EUI_t must be installed and commissioned prior to the compliance date. Should the building fail to meet the EUI_t after the measurement and verification requirements required in Section 4.3.3.3, Verification of compliance have been completed, the building shall implement additional EEMs to and demonstrate the building EUI is less than the EUI_t.

- Form A
- Form B
- Form C, except buildings unable to meet Section 5.2, Building energy monitoring.
- Energy audit report.
 - Level 2 Energy audit
 - Normative Annex X – Investment Criteria Form.
- Continued reporting until completion as specified in Section Z4.6.

Z4.5 Buildings that will meet the building investment criteria through conditional compliance. Building owners must provide the following documentation to verify that the building has implemented all EEMs that meet the cost effectiveness criteria resulting from the energy audit and economic evaluation criteria from Normative Annex X. The energy management plan must be completed and implemented and all EEMs must be installed and commissioned prior to the compliance date. Should the building fail to meet the EUI_t after the measurement and verification requirements required in Section 4.3.3.3, Verification of compliance have been completed, the building shall implement additional EEMs to meet the projected target.

- Form A
- Form B
- Form C, except buildings unable to meet Section 5.2, Building energy monitoring.
- Energy audit report.
 - Level 2 Energy audit
 - Normative Annex X – Investment Criteria Form.
- Continued reporting until completion as specified in Section Z4.6.

Z4.5.1 Phased implementation. The building owner may include phased implementation of EEMs such that the *building owner* is not required to replace a system or equipment before the end of the system or equipment's useful life. System or equipment fitting this description shall be included in the energy audit and Normative Annex X - Investment Criteria submission with a schedule for replacement. Phased implementation shall be documented in the *energy management plan* and *capital management plan* required in section 5.

Z4.6 Continued reporting until completion. Continued reporting is required as specified in sections Z4.6.1 and Z4.6.2 until completion when: a) measurement and verification extends one year or more beyond the compliance date, or b) implementation is extended phased implementation.

Z4.6.1 Annual reporting. The following up to date reports shall be submitted to the AHJ annually, (date specific).

- Form A
- Form B
- Form C, except buildings unable to meet Section 5.2, Building energy monitoring.

Z4.6.2 Completion Reporting. The following up to date reports shall be submitted to the AHJ when all conditions of compliance have been verified and documented:

- Form A
- Form B
- Form C, except buildings unable to meet Section 5.2, Building energy monitoring. Buildings unable to meet section 5.2 shall include the verification specified in section 9.2.2 in the building *energy management plan*.

Z5 Violations, assessment of administrative penalties, mitigation and review of penalty decisions.

Z5.1 Authorization. The AHJ is authorized to impose administrative penalties upon building owners for failing to submit documentation demonstrating compliance with the requirements of this standard.

Failure to submit documentation demonstrating compliance by the scheduled reporting date will result in progressive penalties by legal notice.

Z5.2 Notice of violation and opportunity to correct (NOVC) (first notice).

Z5.2.1 The department may issue a NOVC when a building owner has failed to submit documentation that demonstrates compliance with this standard by the scheduled reporting date.

Z5.2.2 A NOVC may be issued for any of the following reasons:

1. Failure to submit a compliance report in the form and manner prescribed by the AHJ;
2. Failure to meet an energy use intensity target or failure to receive conditional compliance approval;
3. Failure to provide accurate reporting consistent with the requirements of the standard; and
4. Failure to provide a valid exemption certificate.

The AHJ will identify in the NOVC which section(s) of law, code, or the standard for which the building owner has failed to demonstrate compliance.

Z5.2.3 The NOVC will specify the time by which the building owner must cure the violation by submitting documentation that demonstrates compliance with the identified section(s) of law, code, or the standard. The AHJ will give the building owner at least seven calendar days to submit such documentation.

Z5.2.4 If sufficient documentation is not submitted by the date specified in the NOVC, the AHJ will issue a notice of violation and intent to assess administrative penalties (NOVI) and the *building owner* will be subject to administrative penalties.

Z5.3 Notice of violation and intent to assess administrative penalties (NOVI) (second notice).

Z5.3.1 If a *building owner* fails to respond to a NOVC by submitting documentation demonstrating compliance by the date specified in the NOVC, the AHJ will issue a Notice of Violation and Intent to Assess Administrative Penalties (“NOVI”).

Z5.3.2 The AHJ will identify in the NOVI which section(s) of law, code, or the standard for which the building owner has failed to demonstrate compliance. The NOVI will also include a description of how the penalties the AHJ intends to assess will be calculated.

Building owners must respond to a NOVI within thirty days by either:

1. Submitting an application for exemption in accordance with Section Z4.1 if applicable;
2. Submitting a Non-Compliance mitigation plan in accordance with Z5.7;
3. Submitting its intent to pay the penalties by using the form provided by the AHJ; or
4. Submitting a request for an administrative proceeding to challenge or mitigate the penalty.

Z5.3.3 If the *building owner* does not timely request a hearing or submit an application for exemption, the *building owner* waives its right to a hearing and the director or their designee may issue a final order assessing the penalties described in the NOVI. If the *building owner* has submitted a mitigation plan, the final order will only assess penalties from the scheduled compliance date until the date of an approval of compliance or conditional compliance.

Z5.3.4 Building owners who submit an application for exemption that is denied may request a hearing by submitting a request for a hearing within thirty days of issuance of the decision denying its application for exemption. If the building owner does not request a hearing within thirty days, the building owner waives its right to a hearing and the director or their designee may issue a final order assessing the penalties described in the NOVI.

Z5.4 Assessment of administrative penalties.

Z5.4.1 Failure to submit documentation demonstrating compliance with the standard by the date specified in a NOVC will result in the issuance of a NOVI and the assessment of administrative penalties at an amount not to exceed five thousand dollars plus an amount based on the duration of any continuing violation. The additional amount for a continuing violation may not exceed a daily amount equal to one dollar per year per gross square foot of floor area.

Z5.4.1.1 Penalties for building owners that submit a non-compliance mitigation plan. For building owners subject to a NOVI who respond within thirty (30) days by submitting a non-compliance mitigation plan (Z5.7), fines shall be assessed on an annual basis or when the building owner achieves compliance or conditional compliance.

(a) For applicants that submit a non-compliance mitigation plan and who submit documentation demonstrating completion, daily penalties will be assessed from the scheduled compliance date to the date of Approval of Compliance or Conditional Compliance. The penalty will be assessed at an amount not to exceed 30% of five thousand dollars plus a daily amount equal to \$0.20 per gross square foot of floor area per year.

(b) For applicants that submit a non-compliance mitigation plan but have not submitted documentation demonstrating completion, if the building does not comply with the standard by the next compliance date, the building owner will be assessed the maximum penalty of five thousand dollars plus a daily amount equal to \$1.00 per gross square foot of floor area per year not to exceed a value greater than 18 months of accrued penalty.

The AHJ may by rule increase the penalty rates to adjust for the effects of inflation.

Z5.4.2 When assessed penalties are not paid within one hundred and eighty (180) days of the date of a final order assessing penalties, the AHJ may assess further penalties. Total penalties assessed will not exceed five thousand dollars plus a daily amount equal to \$1.00 per gross square feet of floor area per year.

Z5.4.3 Interest will accrue on civil penalties pursuant to RCW 43.17.240 if and when the debt becomes past due.

Z5.5 Due date and collection of penalties.

Z5.5.1 Penalties shall become due and payable on the later of:

1. Thirty days after receipt of the final order imposing the penalty; or
2. The date specified in the final order imposing the penalty.

Z5.5.2 If a penalty has not been paid by the due date, the AHJ may assign the debt to a collection agency as authorized by RCW 19.16.500 or take other action to pursue collection as authorized by law. If referred to a collection agency, the AHJ may add a reasonable fee, payable by the debtor, to the outstanding debt for the collection agency fee.

Z5.5.3 For building owners that are implementing a non-compliance mitigation plan but have not yet complied, the AHJ may assess the accumulated daily fine on June 1 of each year or shortly thereafter.

Z5.6 Payment of administrative penalties.

A check or money order payable in U.S. funds to the Washington state department of commerce can be mailed to:

Washington State Department of Commerce
Re: Clean Buildings Initiative, Energy Division
P.O. Box 42525
Olympia, WA 98504-2525

Z5.7 Non-Compliance Mitigation Plan. Owners of covered commercial buildings that are out of compliance by the scheduled compliance date and have not corrected the violation by the date noted in a NOVC may reduce possible penalties by demonstrating that they are taking action to achieve compliance with the standard. To begin the process of mitigating non-compliance, a building owner must submit to the AHJ the Non-Compliance Mitigation Plan form selecting one of the following actions within thirty (30) days of the date of a NOVI to avoid immediate issuance of penalty in accordance with Z5.4.1.

- (a) Compliance with the standard in accordance with Z4.2.
- (b) Conditional compliance with the standard in accordance with Z4.4.
- (c) Conditional compliance with the standard in accordance with Z4.5.

Z5.7.1 Mitigation Completion. To demonstrate completion, the building owner shall complete all of the requirements of this standard and submit documentation as required by section Z4.2, Z4.4 or Z4.5. Upon completion, the AHJ shall issue a final order assessing the reduced penalty as specified by Z5.4.1.1(a).

Z5.8 Administrative hearings.

Z5.8.1 Requesting a hearing. A building owner may request an administrative hearing after receiving an NOVI or after the denial of its application for an exemption by submitting a request within thirty days of the date of a NOVI or the denial of a timely application for exemption. All requests must be made in writing and filed at the address specified on the NOVI. For convenience, the AHJ will attach a form titled request for hearing to the NOVI that may be used to request an administrative hearing.

Requests for hearing must be accompanied by the following:

1. Washington State Building ID;
2. Submit Annex Z Forms A, B, and C.

Z5.8.2 Hearing process. The AHJ may refer matters to the office of administrative hearings (OAH). Administrative hearings will be conducted in accordance with chapter 34.05 WAC, Administrative Procedure Act, chapter 10-08 WAC, Model rules of procedure, and the procedural rules adopted in this chapter. In the case of a conflict between the model rules of procedure and the procedural rules adopted in this section, the procedural rules adopted in this section take precedence.

Z5.8.3 Initial orders to become final orders. Initial orders issued by the presiding officer will become final without further agency action unless, within twenty days:

1. The director determines that the initial order should be reviewed; or
2. A party to the proceeding files a petition for administrative review of the initial order. Upon occurrence of either event, notice shall be given to all parties to the proceeding.

Z5.8.4. Judicial review. A final order entered pursuant to this section is subject to judicial review pursuant to RCW 34.05.510 through 34.05.598.

Z5.8.5 Collected penalties. The AHJ will deposit all penalties collected and received by the department under this section into the low-income weatherization and structural rehabilitation assistance account created in RCW 70.164.030.

Z6 Compliance forms. The following section replace Normative Annex C Forms in Standard 100 and provide additional forms specified by rule Building owners are required to submit the applicable forms and the required supporting information to demonstrate compliance with the standard. These forms replace all referenced forms in this standard. The AHJ will make these forms available in an electronic format for submission to the AHJ.

Z6.1 Compliance with Standard 100 (Form A)

1. Building identification:
 - a. WA state building ID;
 - b. County;
 - c. County parcel number(s);
 - d. Portfolio manager property ID number;
 - e. Property name;
 - f. Parent property name;
 - g. Address 1 (street);
 - h. Address 2;
 - i. City;
 - j. State; and
 - k. Postal code.
2. Contact information:
 - a. *Building owner* name(s);
 - b. Contact name;
 - c. Address 1 (street);
 - d. Address 2;
 - e. City;
 - f. State/Province;
 - g. Country;
 - h. Postal code;
 - i. Telephone number;
 - j. Email address.
3. Qualified person:
 - a. Qualified person name;
 - b. Address 1 (street);
 - c. Address 2;
 - d. City;
 - e. State;
 - f. Postal code;
 - g. Telephone number;
 - h. Email address;
 - i. Licensed, certified (select all that apply);
 - ii. Licensure or certifying authority;
4. *Energy manager* (if different than the qualified person):
 - a. Energy manager name;
 - b. Address 1 (street);
 - c. Address 2;
 - d. City;
 - e. State/Province;
 - f. Postal code;
 - g. Country;
 - h. Telephone number;
 - i. Email address.
5. This compliance report is for:
 - a. Building that meets the EUI_t .
 - b. Building that meets the building investment criteria prior to the compliance date.
 - c. Building that will meet the EUI_t through conditional compliance.
 - d. Building that will meet the building investment criteria through conditional compliance.
 - e. Annual reporting
 - f. Completion reporting
6. Summary data:

- a. Energy utilization index target (EUI_t) (kBtu/ft² yr) based on completed Z6.2 Form B.
 - b. Measured site EUI (kBtu/ft²) for the compliance year for this building based on Z6.3 Form C.
 - c. Measured weather normalized site EUI (kBtu/ft²) for the compliance year based on Z6.3 Form C.
 - d. List the months/year of the collected data (mm/yyyy - mm/yyyy) for the compliance year for this building from Z6.3 Form C.
 - e. Buildings unable to comply with Section 5.2, Building energy monitoring and complete Z6.3 Form C shall provide a reason statement.
7. Have the energy management requirements of Section 5 been met? Yes No
 - Upload energy management plan as specified by the AHJ.
 8. Have the operation and maintenance requirements of Section 6 been met? Yes No
 - Upload operation and maintenance implementation documentation as specified by the AHJ.
 9. Date the audit and economic evaluation was completed (N/A if none required).
 - Upload audit reports as specified by Z6.4 Form D.
 10. Have all EEMs required by Section 8 been implemented? Yes No
 11. Have the requirements of Section 9 been completed? Yes No
 12. We state that this building complies with ANSI/ASHRAE/IES Standard 100 as amended by the AHJ to conform with RCW 19.27A.210:
 - a. Signature of building owner:
 - Date:
 - b. Signature of qualified person:
 - Date:
 - c. Signature of energy manager:
 - Date:
 - d. Signature of authority having jurisdiction:
 - Conditional or final compliance
 - Date:

Z6.2 Building activity and energy use intensity target (EUI_t)(Form B). - Complete form provided by the AHJ with the following information:

1. Building identification:
 - a. Washington state building ID;
 - b. County;
 - c. County parcel number(s);
 - d. Portfolio manager property ID number;
 - e. Property name;
 - f. Parent property name;
 - g. Address 1 (street);
 - h. Address 2;
 - i. City;
 - j. State; and
 - k. Postal code.
 2. List the building location climate zone, 4C or 5B. Determine the climate zone using ASHRAE climate zone as found on the map in Informative Annex G. Buildings located in Climate Zone 6 shall use Climate Zone 5B.
 3. The gross floor area in square feet shall be reported as defined in Section 3.
 4. If entire building is single activity/type not listed in Table 7-1, it should be listed as "building without target" on Z6.1 form. List "energy target" as "N/A" on Z6.2 Form B and Z6.2 Form B is considered complete.
 5. Fill in fraction of gross floor area (A)_i for each activity. For single-activity buildings this is 1.0.
 6. Fill in the operating shifts normalization factor (S)_i from Table 7-3 for each activity that has an area entered from Step 6.
 7. Fill in the activity energy target (EUI_{t,1})_i from Table 7-2 (or table from AHJ) for each activity that has an area entered from Step 6.
 8. Calculate weighted space EUI target ($A \times S \times EUI_{t,1}$)_i for each activity that has an area entered from Step 6.
 9. Add up fraction of floor area and enter sum in "Total fraction of floor area with target," and add up all weighted space EUI targets and enter sum as the "energy target" on Z6.2 and Z6.1 Forms B and A.
 10. If more than 50% of gross floor area has no target, it should be listed as "building without target" on Z6.1 Form A. List "energy target" as "N/A" on Z6.2 Form B.
- For single-activity *buildings* this is 1.0.

Z6.3 Energy-Use intensity Calculations (Form C).

Energy Use Intensity Calculations shall be reported via the U.S. EPA's ENERGY STAR Portfolio Manager (www.energystar.gov/benchmark). The *energy manager* is responsible for creating Energy Star portfolio manager record for each building.

Exception to Z6.3: Buildings unable to comply with Section 5.2, Building energy monitoring shall demonstrate compliance through Z4.3 or Z4.5.

The Energy Star portfolio manager building record shall be identical to the building activity/type, fraction floor area, operating shifts (hours of operation) and gross floor area of the building as reported on Form B. All inputs shall be up to date prior to reporting as required in Section Z4 and annually as required in Section 5.1.2.3, Annual updates of the *net energy* use and *EUI*.

Prior to submitting reports run the Energy Star portfolio manager data quality checker and make all corrections required to complete the report.

The energy manager shall use the EPA's Energy Star portfolio manager share properties feature and share the property data with the AHJ by enabling the read only access and exchange data feature.

For each report submitted under Section Z4, the energy manager shall create and submit a report documenting the required data fields listed (below) and other fields deemed necessary by the AHJ for the reporting period. This shall be submitted using the Washington state report specified in Energy Star portfolio manager.

Report fields shall include:

- Portfolio manager property ID;
- Portfolio manager parent property ID;
- Property name;
- Parent property name;
- Address 1;
- Address 2;
- City;
- County;
- State/Province;
- Postal Code;
- Primary property type - Self-selected;
- Primary property type - EPA calculated;
- List of all property use types at property;
- Property GFA - Self-reported (ft²);
- Property GFA - EPA calculated (buildings and parking) (ft²);
- Property GFA - EPA calculated (buildings) (ft²);
- Property GFA - EPA calculated (parking) (ft²);
- Largest property use type;
- Largest property use type - Gross floor area (ft²);
- 2nd Largest property use type
- 2nd Largest property use - Gross floor area (ft²);
- 3rd Largest property use type;
- 3rd Largest property use type - Gross floor area (ft²);
- Year built;
- Occupancy;
- Property notes;
- Property data administrator;
- Property data administrator - Email;
- Last modified date - Property;
- Last modified date - Electric meters;
- Last modified date - Gas meters;
- Last modified date - Nonelectric nongas energy meters;
- Local standard ID(s) Washington state building standard;
- Data center - Energy estimates applied;
- Electricity use - Grid purchase and generated from on-site renewable systems (kWh);
- Electricity use - Grid purchase (kWh);
- Electricity use – Generated from on-site renewable systems and used on-site (kWh);
- Natural gas use (therms);
- Fuel oil #1 use (kBtu);
- Fuel oil #2 use (kBtu);
- Fuel oil #4 use (kBtu);
- Fuel oil #5 and 6 use (kBtu);

- Diesel #2 use (kBtu);
- Kerosene use (kBtu);
- Propane use (kBtu);
- District steam use (kBtu);
- District hot water use (kBtu);
- District chilled water use (kBtu);
- Coal - Anthracite use (kBtu);
- Coal - Bituminous use (kBtu);
- Coke use (kBtu);
- Wood use (kBtu);
- Other use (kBtu);
- Default values;
- Temporary values;
- Estimated data flag - Electricity (grid purchase);
- Estimated data flag - Natural gas;
- Alert - Data center does not have an IT meter;
- Alert - Gross floor area is 0 ft²;
- Alert - Property has no uses;
- Data quality checker - Date run;
- Data quality checker run - ?
- Alert - Energy meter has less than 12 full calendar months of data;
- Alert - Energy meter has gaps;
- Alert - Energy meter has overlaps;
- Alert - Energy - No meters selected for metrics;
- Alert - Energy meter has single entry more than sixty-five days;
- Estimated values - Energy;
- Energy Star score;
- National median site energy use (kBtu);
- Site energy use (kBtu);
- Site EUI (kBtu/ft²);
- Weather normalized site energy use (kBtu);
- Weather normalized site EUI (kBtu/ft²);
- Weather normalized site electricity (kWh);
- Weather normalized site electricity intensity (kWh/ft²);
- Weather normalized site natural gas use (therms);
- Weather normalized site natural gas intensity (therms/ft²) energy current date;
- Electricity use - Generated from on-site renewable systems (kWh);
- Electricity use – Generated from on-site renewable systems and exported (kWh);
- Electricity Use - Grid purchase and generated from on-site renewable systems (kBtu);
- Electricity use - Grid purchase (kBtu);
- Electricity use - Generated from on-site renewable systems and used on site (kBtu);
- Natural gas use (kBtu);
- Percent of total electricity generated from on-site renewable systems;
- Cooling degree days (CDD) (°F);
- Heating degree days (HDD) (°F);
- Weather station name;
- Weather station ID.

Z6.4 End-use analysis requirements. Building owners shall demonstrate compliance with Form D by providing the documentation required by section Z6.4.1.

Z6.4.1 Energy Audit Forms (Form D). The energy audit form shall be provided electronically by completing the energy audit form included in the U.S. Department of Energy, Energy Asset Score Tool, or an equivalent tool provided by the AHJ. This form shall be completed in compliance with the level 2 energy audit, as published in ASHRAE Standard 211, Standard for commercial building energy audits.

Form E - Not adopted.

Z6.5 Annex X, Investment criteria tool (Form F).

Z6.5.1 To demonstrate compliance with the investment criteria of Normative Annex X, building owners shall complete and submit Form F.

Z6.5.2 Form F shall be developed by the AHJ. Form F shall be a life cycle cost evaluation tool compliant the NIST Standard 135 and capable of supporting the evaluation criteria required by Normative Annex X.

Z6.6 Documentation of a building of historic significance (Form G).

Energy efficiency measure exemptions for historic buildings. No individual energy efficiency measure identified by energy efficiency audits need to be implemented if it would compromise the historical integrity of a building or part of a building. Building owners seeking this exception shall provide the following documentation. Certified historic buildings are not exempt from the other requirements of this standard.

Plan for compliance. The owner of a qualifying historic building shall have the plan for compliance evaluated by a qualified historic preservationist, as defined in 36 C.F.R., Part 61, identifying any energy efficiency requirement that may compromise the historic integrity of the building or part of the building. Any element of the plan identified to compromise the historic integrity of the building or part of the building shall be omitted from the compliance plan. Evidence of this evaluation must be submitted to the AHJ for approval.

Documentation of a historic building. Building owners must provide documentation to the AHJ that proves its historic identification or eligibility. Valid documentation from any existing programs listed below is acceptable.

1. Examples of existing programs that verify historic property include:
 - a. The National Register of Historic Places;
 - b. The Washington heritage register;
 - c. Properties that are identified by the department of archaeology and historic preservation (DAHP) to be eligible for listing in either one of these registers; and
 - d. Properties which are listed in a local register of historic places; or
2. Other documentation approved by the AHJ.

Z6.7 Application for Exemption Certificate (Form H).

Apply for an exemption certificate by submitting the following documentation to the building owner in the form specified by the AHJ. The application must include:

1. Building identification
 - a. Washington state building ID;
 - b. County;
 - c. County parcel number(s);
 - d. Portfolio manager property ID number;
 - e. Property name;
 - f. Parent property name;
 - g. Address 1 (street);
 - h. Address 2;
 - i. City;
 - j. State; and
 - k. Postal code.
2. Contact information:
 - a. Building owner name(s);
 - b. Contact name;
 - c. Address 1 (street);
 - d. Address 2;
 - e. City;
 - f. State/Province;
 - g. Country;
 - h. Postal code;
 - i. Telephone number; and
 - j. Email address.
3. Building information:
 - a. Primary building activity from Table 7-1, or a description of the nonlisted building type;
 - b. Building gross floor area;
 - c. Building gross conditioned floor area.
4. Reason for exemption: Based on exemptions listed in Section Z4.1(2).

A list all of documents enclosed and any facts in support of this application. Provide at least two of the acceptable documents listed below:

- a. Municipal or county records;
- b. Documents from a qualified person;

- c. Construction permit;
 - d. Certificate of occupancy or application for certificate of occupancy;
 - e. Demolition permit;
 - f. Financial statements such as statement of assets; liabilities, capital, and surplus, statement of revenue and expenses; or statement of case flow;
 - g. A letter from the building owner stating facts and explaining financial hardships;
 - h. More recently built buildings that obtained an original occupancy permit no more than three years prior to the compliance date specified in Z3.1; or
 - i. Approved documents by the AHJ.
5. Signature and statement of *building owner* stating that the authorized representative of the building, affirm and attest to the accuracy, truthfulness and completeness of the statements of material fact provided in this form.

Z7 Section 7—Tables as modified by Washington state.

Table 7-1 Commercial Building Types/Activities

Building Activity Type^{1,2}				
No.	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed	Notes
1	Banking/financial services	Bank Branch		
2	Banking/financial services	Financial Office		
3	Education	Adult Education		
4	Education	College/University		
5	Education	K-12 School	Elementary/middle school	
6	Education	K-12 School	High school	
7	Education	Pre-school/Daycare		
8	Education	Vocational School		
9	Education	Other – Education		
10	Entertainment/public assembly	Aquarium		
11	Entertainment/public assembly	Bar/Nightclub		
12	Entertainment/public assembly	Bowling Alley		
13	Entertainment/public assembly	Casino		
14	Entertainment/public assembly	Convention Center		
15	Entertainment/public assembly	Fitness Center/Health Club/Gym		
16	Entertainment/public assembly	Ice/Curling Rink		
17	Entertainment/public assembly	Indoor Arena		
18	Entertainment/public assembly	Movie Theater		
19	Entertainment/public assembly	Museum		
20	Entertainment/public assembly	Performing Arts		
21	Entertainment/public assembly	Race Track		
22	Entertainment/public assembly	Roller Rink		
23	Entertainment/public	Social/Meeting Hall		

	assembly			
24	Entertainment/public assembly	Stadium (Closed)		
25	Entertainment/public assembly	Stadium (Open)		
26	Entertainment/public assembly	Swimming Pool		
27	Entertainment/public assembly	Zoo		
28	Entertainment/public assembly	Other – Entertainment/Public Assembly	Entertainment/culture	
29	Entertainment/public assembly	Other – Entertainment/Public Assembly	Library	
30	Entertainment/public assembly	Other – Entertainment/Public Assembly	Other public assembly	

Continued

Table 7-1 Commercial Building Types/Activities

Building Activity Type^{1,2}				
No.	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed	Notes
31	Entertainment/public assembly	Other – Entertainment/Public Assembly	Recreation	
32	Entertainment/public assembly	Other – Entertainment/Public Assembly	Social/meeting	
33	Entertainment/public assembly	Other – Recreation		
34	Entertainment/public assembly	Other – Stadium		
35	Food sales and service	Bar/Nightclub		
36	Food sales and service	Convenience Store with Gas Station		
37	Food sales and service	Convenience Store without Gas Station		
38	Food sales and service	Fast Food Restaurant		
39	Food sales and service	Food Sales	Grocery/food market	
40	Food sales and service	Food Sales	Convenience store with gas	
41	Food sales and service	Food Sales	Convenience store	
42	Food sales and service	Food Sales	Other food sales	
43	Food sales and service	Food Service	Fast Food	
44	Food sales and service	Food Service	Restaurant/cafeteria	
45	Food sales and service	Food Service	Other food service	
46	Food sales and service	Restaurant		
47	Food sales and service	Supermarket/Grocery Store		
48	Food sales and service	Wholesale Club/Supercenter		
49	Food sales and service	Other – Restaurant/Bar		
50	Healthcare	Ambulatory Surgical Center		
51	Healthcare	Hospital (General Medical & Surgical)*		
52	Healthcare	Medical Office		3
53	Healthcare	Outpatient Rehabilitation/Physical Therapy		

54	Healthcare	Residential Care Facility		
55	Healthcare	Senior Care Community		
56	Healthcare	Urgent Care/Clinic/Other Outpatient		
57	Healthcare	Other – Specialty Hospital		
58	Lodging/residential	Barracks		
59	Lodging/residential	Hotel	Hotel	
60	Lodging/residential	Hotel	Motel or Inn	

Continued

Table 7-1 Commercial Building Types/Activities

Building Activity Type^{1,2}				
No.	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed	Notes
61	Lodging/residential	Multifamily Housing		
62	Lodging/residential	Prison/Incarceration		
63	Lodging/residential	Residence Hall/Dormitory		
64	Lodging/residential	Residential Care Facility		
65	Lodging/residential	Senior Care Community		
66	Lodging/residential	Other – Lodging/Residential		
67	Mixed use	Mixed Use Property		4
68	Office	Medical Office		3
69	Office	Office	Admin/professional office	
70	Office	Office	Bank/other financial	
71	Office	Office	Government office	
72	Office	Office	Medical Office (Diagnostic)	3
73	Office	Office	Other office	
74	Office	Veterinary Office		
75	Office	Other – Office		
76	Public services	Courthouse		
77	Public services	Fire Station		
78	Public services	Library		
79	Public services	Mailing Center/Post Office		
80	Public services	Police Station		
81	Public services	Prison/Incarceration		
82	Public services	Social/Meeting Hall		
83	Public services	Transportation Terminal/Station		
84	Public services	Other – Public Service		
85	Religious worship	Worship Facility		
86	Retail	Automobile Dealership		
87	Retail	Convenience Store with Gas Station		
88	Retail	Convenience Store without Gas Station		
89	Retail	Enclosed Mall		5
90	Retail	Lifestyle Center	Enclosed mall	5

Continued

Table 7-1 Commercial Building Types/Activities

Building Activity Type^{1,2}				
No.	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed	Notes
91	Retail	Lifestyle Center	Other retail	
92	Retail	Lifestyle Center	Retail Store	
93	Retail	Lifestyle Center		4
94	Retail	Retail Store		
95	Retail	Strip Mall		4
96	Retail	Supermarket/Grocery Store		
97	Retail	Wholesale Club/Supercenter		
98	Retail	Other – Retail/Mall	Enclosed mall	5
99	Retail	Other – Retail/Mall		4
100	Technology/science	Data Center		6
101	Technology/science	Laboratory		
102	Technology/science	Other – Technology/Science	Other service	
103	Services	Personal Services (Health/Beauty, Dry Cleaning, etc)		
104	Services	Repair Services (Vehicle, Shoe, Locksmith, etc)	Repair shop	
105	Services	Repair Services (Vehicle, Shoe, Locksmith, etc)	Vehicle service/repair shop	
106	Services	Repair Services (Vehicle, Shoe, Locksmith, etc)	Vehicle storage/maintenance	
107	Services	Other – Services		
108	Utility	Energy/Power Station		7
109	Utility	Other – Utility		7
110	Warehouse/storage	Self-Storage Facility		
111	Warehouse/storage	Distribution Center		
112	Warehouse/storage	Non-Refrigerated Warehouse		
113	Warehouse/storage	Refrigerated Warehouse		

Notes:

1. Select the most specific building activity type that applies.
2. For Building Type Definitions See Energy Star Portfolio Manager Definitions except as follows:

Data center: is a activity space designed and equipped to meet the needs of high density computing equipment, such as server racks, used for data storage and processing, including dedicated uninterruptible power supplies and cooling systems and require a constant power load of 75 kW or more. Gross floor area shall only include space within the building including raised floor computing space, server rack aisles, storage silos, control console areas, battery rooms and mechanical rooms for dedicated cooling equipment. Gross floor area shall not include a server closet, telecommunications equipment closet, computer training area, office, elevator, corridors or other auxiliary space.

Urgent Care Center/Clinic/Other Outpatient Office means the buildings used to diagnose and treat patients, usually on an unscheduled, walk-in basis, who have an injury or illness that requires immediate care but is not serious enough to warrant a visit to an emergency department. Includes facilities that provide same-day surgical, diagnostic and preventive care.

3. All medical offices considered to be diagnostic type
4. Must Use use of section 7.2.3 method for mixed use buildings
5. Suggest considering use of section 7.2.3 method for mixed use buildings
6. This is a building or activity without an energy target. Included to provide definition only.
7. This is a building or activity without an energy target. This may be exempt from the standard, see section Z4.1 2, d.

Table 7-2a Building Activity Site Energy Targets (EUIt1) (I-P Units)

No.	Building Activity Type ^{1,2}			Notes	Climate Zone 4 C	Climate Zone 5B
	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed		EUIt	EUIt
1	Banking/financial services	Bank Branch			69	71
2	Banking/financial services	Financial Office			69	71
3	Education	Adult Education			49	51
4	Education	College/University			102	102
5	Education	K-12 School	Elementary/middle school		49	50
6	Education	K-12 School	High school		48	49
7	Education	Pre-school/Daycare			59	59
8	Education	Vocational School			49	51
9	Education	Other – Education			49	51
10	Entertainment/public assembly	Aquarium			55	59
11	Entertainment/public assembly	Bar/Nightclub			55	59
12	Entertainment/public assembly	Bowling Alley			73	78
13	Entertainment/public assembly	Casino			55	59
14	Entertainment/public assembly	Convention Center			50	52
15	Entertainment/public assembly	Fitness Center/Health Club/Gym			73	78
16	Entertainment/public assembly	Ice/Curling Rink			73	78
17	Entertainment/public assembly	Indoor Arena			67	70
18	Entertainment/public assembly	Movie Theater			67	70
19	Entertainment/public assembly	Museum			67	70
20	Entertainment/public assembly	Performing Arts			55	59
21	Entertainment/public assembly	Race Track			67	70
22	Entertainment/public assembly	Roller Rink			73	78
23	Entertainment/public assembly	Social/Meeting Hall			50	52
24	Entertainment/public assembly	Stadium (Closed)			67	70
25	Entertainment/public assembly	Stadium (Open)			67	70
26	Entertainment/public assembly	Swimming Pool			73	78
27	Entertainment/public assembly	Zoo			55	59
28	Entertainment/public assembly	Other – Entertainment/Public Assembly	Entertainment/culture		67	70
29	Entertainment/public assembly	Other – Entertainment/Public Assembly	Library		56	59
30	Entertainment/public assembly	Other – Entertainment/Public Assembly	Other public assembly		55	59

Continued

Table 7-2a Building Activity Site Energy Targets (EUI_{t1}) (I-P Units)

No.	Building Activity Type ^{1,2}			Notes	Climate Zone 4 C	Climate Zone 5B
	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed		EUI _t	EUI _t
31	Entertainment/public assembly	Other – Entertainment/Public Assembly	Recreation		73	78
32	Entertainment/public assembly	Other – Entertainment/Public Assembly	Social/meeting		50	52
33	Entertainment/public assembly	Other – Recreation			73	78
34	Entertainment/public assembly	Other – Stadium			67	70
35	Food sales and service	Bar/Nightclub			361	378
36	Food sales and service	Convenience Store with Gas Station			244	253
37	Food sales and service	Convenience Store without Gas Station			260	269
38	Food sales and service	Fast Food Restaurant			427	454
39	Food sales and service	Food Sales	Grocery/food market		191	198
40	Food sales and service	Food Sales	Convenience store with gas		260	269
41	Food sales and service	Food Sales	Convenience store		244	253
42	Food sales and service	Food Sales	Other food sales		184	189
43	Food sales and service	Food Service	Fast Food		427	454
44	Food sales and service	Food Service	Restaurant/cafeteria		361	378
45	Food sales and service	Food Service	Other food service		293	308
46	Food sales and service	Restaurant			361	378
47	Food sales and service	Supermarket/Grocery Store			191	198
48	Food sales and service	Wholesale Club/Supercenter			68	75
49	Food sales and service	Other – Restaurant/Bar			361	378
50	Healthcare	Ambulatory Surgical Center			90	96
51	Healthcare	Hospital (General Medical & Surgical)*			215	215
52	Healthcare	Medical Office		3		
53	Healthcare	Outpatient Rehabilitation/Physical Therapy			90	96
54	Healthcare	Residential Care Facility			78	82
55	Healthcare	Senior Care Community			78	82
56	Healthcare	Urgent Care/Clinic/Other Outpatient			90	96
57	Healthcare	Other – Specialty Hospital			196	196
58	Lodging/residential	Barracks			88	90
59	Lodging/residential	Hotel	Hotel		68	72
60	Lodging/residential	Hotel	Motel or Inn		74	77

Continued

Table 7-2a Building Activity Site Energy Targets (EUI_t1) (I-P Units)

No.	Building Activity Type ^{1,2}			Notes	Climate Zone 4 C	Climate Zone 5B
	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed		EUI _t	EUI _t
61	Lodging/residential	Multifamily Housing			32	33
62	Lodging/residential	Prison/Incarceration			101	106
63	Lodging/residential	Residence Hall/Dormitory			88	90
64	Lodging/residential	Residential Care Facility			78	82
65	Lodging/residential	Senior Care Community			78	82
66	Lodging/residential	Other – Lodging/Residential			71	74
67	Mixed use	Mixed Use Property		4		
68	Office	Medical Office		3	60	65
69	Office	Office	Admin/professional office		63	66
70	Office	Office	Bank/other financial		69	71
71	Office	Office	Government office		66	69
72	Office	Office	Medical Office (Diagnostic)	3	60	65
73	Office	Office	Other office		66	68
74	Office	Veterinary Office			90	96
75	Office	Other – Office			66	68
76	Public services	Courthouse			101	106
77	Public services	Fire Station			65	68
78	Public services	Library			56	59
79	Public services	Mailing Center/Post Office			51	54
80	Public services	Police Station			65	68
81	Public services	Prison/Incarceration			101	106
82	Public services	Social/Meeting Hall			50	52
83	Public services	Transportation Terminal/Station			55	59
84	Public services	Other – Public Service			66	69
85	Religious worship	Worship Facility			39	42
86	Retail	Automobile Dealership			59	66
87	Retail	Convenience Store with Gas Station			260	269
88	Retail	Convenience Store without Gas Station			244	253
89	Retail	Enclosed Mall		5	58	64
90	Retail	Lifestyle Center	Enclosed mall	5	58	64

Continued

Table 7-2a Building Activity Site Energy Targets (EUI_t1) (I-P Units)

No.	Building Activity Type ^{1,2}			Notes	Climate Zone 4 C	Climate Zone 5B
	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed		EUI _t	EUI _t
91	Retail	Lifestyle Center	Other retail		55	62
92	Retail	Lifestyle Center	Retail Store		68	75
93	Retail	Lifestyle Center		4		
94	Retail	Retail Store			68	75
95	Retail	Strip Mall		4		
96	Retail	Supermarket/Grocery Store			191	198
97	Retail	Wholesale Club/Supercenter			68	75
98	Retail	Other – Retail/Mall	Enclosed mall	5	58	64
99	Retail	Other – Retail/Mall		4		
100	Technology/science	Data Center		6		
101	Technology/science	Laboratory			237	249
102	Technology/science	Other – Technology/Science	Other service		66	69
103	Services	Personal Services (Health/Beauty, Dry Cleaning, etc)			66	69
104	Services	Repair Services (Vehicle, Shoe, Locksmith, etc)	Repair shop		36	39
105	Services	Repair Services (Vehicle, Shoe, Locksmith, etc)	Vehicle service/repair shop		60	64
106	Services	Repair Services (Vehicle, Shoe, Locksmith, etc)	Vehicle storage/maintenance		41	44
107	Services	Other – Services			66	69
108	Utility	Energy/Power Station		7		
109	Utility	Other – Utility		7		
110	Warehouse/storage	Self-Storage Facility			36	44
111	Warehouse/storage	Distribution Center			36	44
112	Warehouse/storage	Non-Refrigerated Warehouse			36	44
113	Warehouse/storage	Refrigerated Warehouse			121	126

Notes:

1. Select the most specific building activity type that applies.
2. For Building Type Definitions See Energy Star Portfolio Manager Definitions except as follows:

Data center: is a activity space designed and equipped to meet the needs of high density computing equipment, such as server racks, used for data storage and processing, including dedicated uninterruptible power supplies and cooling systems and require a constant power load of 75 kW or more. Gross floor area shall only include space within the building including raised floor computing space, server rack aisles, storage silos, control console areas, battery rooms and mechanical rooms for dedicated cooling equipment. Gross floor area shall not include a server closet, telecommunications equipment closet, computer training area, office, elevator, corridors or other auxiliary space.

Urgent Care Center/Clinic/Other Outpatient Office means the buildings used to diagnose and treat patients, usually on an unscheduled, walk-in basis, who have an injury or illness that requires immediate care but is not serious enough to warrant a visit to an emergency department. Includes facilities that provide same-day surgical, diagnostic and preventive care.

3. All medical offices considered to be diagnostic type
4. Must Use use of section 7.2.3 method for mixed use buildings
5. Suggest considering use of section 7.2.3 method for mixed use buildings
6. This is a building or activity without an energy target. Included to provide definition only.
7. This is a building or activity without an energy target. This may be exempt from the standard, see section Z4.1 2, d.

Table 7-3 Building Operating Shifts Normalization Factor

No .	Building Activity Type ^{1,2}			Notes	Weekly Hours ^{1,2}		
	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed		50 or less	51 to 167	168
1	Banking/financial services	Bank Branch		3	0.8	1.0	1.5
2	Banking/financial services	Financial Office		3	0.8	1.0	1.5
3	Education	Adult Education		4	0.9	1.1	1.9
4	Education	College/University		4	0.9	1.1	1.9
5	Education	K-12 School	Elementary/middle school	4	0.9	1.1	1.9
6	Education	K-12 School	High school	4	0.9	1.1	1.9
7	Education	Pre-school/Daycare		4	0.9	1.1	1.9
8	Education	Vocational School		4	0.9	1.1	1.9
9	Education	Other – Education		4	0.9	1.1	1.9
10	Entertainment/public assembly	Aquarium		4	0.6	1.1	1.6
11	Entertainment/public assembly	Bar/Nightclub		4	0.6	1.1	1.6
12	Entertainment/public assembly	Bowling Alley		4	0.6	1.1	1.6
13	Entertainment/public assembly	Casino		4	0.6	1.1	1.6
14	Entertainment/public assembly	Convention Center		4	0.6	1.1	1.6
15	Entertainment/public assembly	Fitness Center/Health Club/Gym		4	0.6	1.1	1.6
16	Entertainment/public assembly	Ice/Curling Rink		4	0.6	1.1	1.6
17	Entertainment/public assembly	Indoor Arena		4	0.6	1.1	1.6
18	Entertainment/public assembly	Movie Theater		4	0.6	1.1	1.6
19	Entertainment/public assembly	Museum		4	0.6	1.1	1.6
20	Entertainment/public assembly	Performing Arts		4	0.6	1.1	1.6
21	Entertainment/public assembly	Race Track		4	0.6	1.1	1.6
22	Entertainment/public assembly	Roller Rink		4	0.6	1.1	1.6
23	Entertainment/public assembly	Social/Meeting Hall		4	0.6	1.1	1.6
24	Entertainment/public assembly	Stadium (Closed)		4	0.6	1.1	1.6
25	Entertainment/public assembly	Stadium (Open)		4	0.6	1.1	1.6
26	Entertainment/public assembly	Swimming Pool		4	0.6	1.1	1.6
27	Entertainment/public assembly	Zoo		4	0.6	1.1	1.6
28	Entertainment/public assembly	Other – Entertainment/Public Assembly	Entertainment/culture	4	0.6	1.1	1.6
29	Entertainment/public assembly	Other – Entertainment/Public Assembly	Library	4	0.6	1.1	1.6

30	Entertainment/public assembly	Other – Entertainment/Public Assembly	Other public assembly	4	0.6	1.1	1.6
Continued							

Table 7-3 Building Operating Shifts Normalization Factor

No.	Building Activity Type ^{1,2}			Notes	Weekly Hours ^{1,2}		
	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed		50 or less	51 to 167	168
31	Entertainment/public assembly	Other – Entertainment/Public Assembly	Recreation	4	0.6	1.1	1.6
32	Entertainment/public assembly	Other – Entertainment/Public Assembly	Social/meeting	4	0.6	1.1	1.6
33	Entertainment/public assembly	Other – Recreation		4	0.6	1.1	1.6
34	Entertainment/public assembly	Other – Stadium		4	0.6	1.1	1.6
35	Food sales and service	Bar/Nightclub		4	0.6	1.1	1.5
36	Food sales and service	Convenience Store with Gas Station		4	0.5	0.9	1.3
37	Food sales and service	Convenience Store without Gas Station		4	0.5	0.9	1.3
38	Food sales and service	Fast Food Restaurant		4	0.6	1.1	1.5
39	Food sales and service	Food Sales	Grocery/food market	4	0.5	0.9	1.3
40	Food sales and service	Food Sales	Convenience store with gas	4	0.5	0.9	1.3
41	Food sales and service	Food Sales	Convenience store	4	0.5	0.9	1.3
42	Food sales and service	Food Sales	Other food sales	4	0.5	0.9	1.3
43	Food sales and service	Food Service	Fast Food	4	0.6	1.1	1.5
44	Food sales and service	Food Service	Restaurant/cafeteria	4	0.6	1.1	1.5
45	Food sales and service	Food Service	Other food service	4	0.6	1.1	1.5
46	Food sales and service	Restaurant		4	0.6	1.1	1.5
47	Food sales and service	Supermarket/Grocery Store		4	0.5	0.9	1.3
48	Food sales and service	Wholesale Club/Supercenter		4	0.6	1.0	1.5
49	Food sales and service	Other – Restaurant/Bar		4	0.6	1.1	1.5
50	Healthcare	Ambulatory Surgical Center		4,7	0.8	1.1	1.3
51	Healthcare	Hospital (General Medical & Surgical)*			1.0	1.0	1.0
52	Healthcare	Medical Office		4,7	0.8	1.0	1.5
53	Healthcare	Outpatient Rehabilitation/Physical Therapy		4,7	0.8	1.1	1.3
54	Healthcare	Residential Care Facility			1.0	1.0	1.0
55	Healthcare	Senior Care Community			1.0	1.0	1.0
56	Healthcare	Urgent Care/Clinic/Other Outpatient		4,7	0.8	1.1	1.3
57	Healthcare	Other – Specialty Hospital			1.0	1.0	1.0
58	Lodging/residential	Barracks			1.0	1.0	1.0
59	Lodging/residential	Hotel	Hotel		1.0	1.0	1.0
60	Lodging/residential	Hotel	Motel or Inn		1.0	1.0	1.0

Continued

Table 7-3 Building Operating Shifts Normalization Factor

No.	Building Activity Type ^{1,2}			Notes	Weekly Hours ^{1,2}		
	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed		50 or less	51 to 167	168
61	Lodging/residential	Multifamily Housing			1.0	1.0	1.0
62	Lodging/residential	Prison/Incarceration			1.0	1.0	1.0
63	Lodging/residential	Residence Hall/Dormitory			1.0	1.0	1.0
64	Lodging/residential	Residential Care Facility			1.0	1.0	1.0
65	Lodging/residential	Senior Care Community			1.0	1.0	1.0
66	Lodging/residential	Other – Lodging/Residential			1.0	1.0	1.0
67	Mixed use	Mixed Use Property		6			
68	Office	Medical Office		4,7	0.8	1.1	1.3
69	Office	Office	Admin/professional office	3	0.8	1.0	1.5
70	Office	Office	Bank/other financial	3	0.8	1.0	1.5
71	Office	Office	Government office	3	0.8	1.0	1.5
72	Office	Office	Medical Office (Diagnostic)	4	0.8	1.1	1.3
73	Office	Office	Other office	3	0.8	1.0	1.5
74	Office	Veterinary Office		3	0.8	1.1	1.3
75	Office	Other – Office		3	0.8	1.0	1.5
76	Public services	Courthouse		4	0.8	0.8	1.1
77	Public services	Fire Station		3	0.8	0.8	1.1
78	Public services	Library		4	0.6	1.1	1.6
79	Public services	Mailing Center/Post Office		3	0.8	1.2	1.3
80	Public services	Police Station		3	0.8	0.8	1.1
81	Public services	Prison/Incarceration			1.0	1.0	1.0
82	Public services	Social/Meeting Hall		4	0.6	1.1	1.6
83	Public services	Transportation Terminal/Station		4	0.6	1.1	1.6
84	Public services	Other – Public Service		4	0.8	1.2	1.3
85	Religious worship	Worship Facility		5	0.9	1.7	1.7
86	Retail	Automobile Dealership		4	0.6	1.0	1.5
87	Retail	Convenience Store with Gas Station		4	0.5	0.9	1.3
88	Retail	Convenience Store without Gas Station		4	0.5	0.9	1.3
89	Retail	Enclosed Mall		4	0.6	1.0	1.5
90	Retail	Lifestyle Center	Enclosed mall	4	0.6	1.0	1.5

Continued

Table 7-3 Building Operating Shifts Normalization Factor

No.	Building Activity Type ^{1,2}			Notes	Weekly Hours ^{1,2}		
	Portfolio Manager Types	Portfolio Manager sub-Types	Sub-Types: Detailed		50 or less	51 to 167	168
91	Retail	Lifestyle Center	Other retail	4	0.6	1.0	1.5
92	Retail	Lifestyle Center	Retail Store	4	0.6	1.0	1.5
93	Retail	Lifestyle Center					
94	Retail	Retail Store		4	0.6	1.0	1.5
95	Retail	Strip Mall					
96	Retail	Supermarket/Grocery Store		4	0.5	0.9	1.3
97	Retail	Wholesale Club/Supercenter		4	0.6	1.0	1.5

98	Retail	Other – Retail/Mall	Enclosed mall	4	0.6	1.0	1.5
99	Retail	Other – Retail/Mall					
100	Technology/science	Data Center					
101	Technology/science	Laboratory		3	1.0	1.0	1.0
102	Technology/science	Other – Technology/Science	Other service	3	0.8	1.2	1.3
103	Services	Personal Services (Health/Beauty, Dry Cleaning, etc)		4	0.8	1.2	1.3
104	Services	Repair Services (Vehicle, Shoe, Locksmith, etc)	Repair shop	4	0.8	1.2	1.3
105	Services	Repair Services (Vehicle, Shoe, Locksmith, etc)	Vehicle service/repair shop	4	0.8	1.2	1.3
106	Services	Repair Services (Vehicle, Shoe, Locksmith, etc)	Vehicle storage/maintenance	4	0.8	1.2	1.3
107	Services	Other – Services		4	0.8	1.2	1.3
108	Utility	Energy/Power Station					
109	Utility	Other – Utility					
110	Warehouse/storage	Self-Storage Facility		4	0.8	1.0	1.4
111	Warehouse/storage	Distribution Center		3	0.8	1.0	1.4
112	Warehouse/storage	Non-Refrigerated Warehouse		3	0.8	1.0	1.4
113	Warehouse/storage	Refrigerated Warehouse		3,8	1.0	1.0	1.4

Notes:

1. Do not count the hours when the property is occupied only by maintenance, security, the cleaning crew, or other support personnel. Do not count the hours when the property is occupied only by maintenance staff.
2. Working hours are based on the average use over the 12 month period selected to document energy use in form C.
3. The weekly hours are the total number of hours per week where the majority of workers are present. If there are 2 or more shifts of workers, add the hours. When developing targets using section 7.2.3 for mixed use buildings, use the hours each separate activity, the hours per week the majority of workers are present.
4. The weekly hours are the hours that be majority of the building is open to serve the public. When developing targets using section 7.2.3 for mixed use buildings, the hours each separate activity is open to the public.
5. The weekly hours the facility is open for operation, which may include worship services, choir practice, administrative use, committee meetings, classes, or other activities.
6. Must Use use of section 7.2.3 method for mixed use buildings.
7. Health care buildings may use other weekly hours if they are required to operate building systems additional hours to protect patient safety. Provide documentation of the requirement in the energy management plan.
8. Refrigerated warehouse greater than 167 hours assumes the workers on shift are loading and/or unloading vehicles.

NOTICE

INSTRUCTIONS FOR SUBMITTING A PROPOSED CHANGE TO THIS STANDARD UNDER CONTINUOUS MAINTENANCE

This standard is maintained under continuous maintenance procedures 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. SSPC consideration will be given to proposed changes within 13 months of receipt by the Senior Manager of Standards (SMOS).

Proposed changes must be submitted to the SMOS in the latest published format available from the SMOS. However, the SMOS may accept proposed changes in an earlier published format if the SMOS concludes that the differences are immaterial to the proposed change submittal. If the SMOS concludes that a current form must be utilized, the proposer may be given up to 20 additional days to resubmit the proposed changes in the current format.

ELECTRONIC PREPARATION/SUBMISSION OF FORM FOR PROPOSING CHANGES

An electronic version of each change, which must comply with the instructions in the Notice and the Form, is the preferred form of submittal to ASHRAE Headquarters at the address shown below. The electronic format facilitates both paper-based and computer-based processing. Submittal in paper form is acceptable. The following instructions apply to change proposals submitted in electronic form.

Use the appropriate file format for your word processor and save the file in either a recent version of Microsoft Word (preferred) or another commonly used word-processing program. Please save each change proposal file with a different name (for example, "prop01.doc," "prop02.doc," etc.). If supplemental background documents to support changes submitted are included, it is preferred that they also be in electronic form as word-processed or scanned documents.

For files submitted attached to an e-mail, ASHRAE will accept an electronic signature (as a picture; *.tif, or *.wpg) on the change submittal form as equivalent to the signature required on the change submittal form to convey non-exclusive copyright.

Submit an e-mail containing the change proposal files to:

change.proposal@ashrae.org

Alternatively, mail paper versions to:

ASHRAE

Senior Manager of Standards

1791 Tullie Circle, NE

Atlanta, GA 30329-2305

Or fax them to:

Attn: Senior Manager of Standards

404-321-5478

The form and instructions for electronic submittal may be obtained from the Standards section of ASHRAE's Home Page, www.ashrae.org, or by contacting a Standards Secretary via phone (404-636-8400), fax (404-321-5478), e-mail (standards.section@ashrae.org), or mail (1791 Tullie Circle, NE, Atlanta, GA 30329-2305).



FORM FOR SUBMITTAL OF PROPOSED CHANGE TO AN ASHRAE STANDARD UNDER CONTINUOUS MAINTENANCE

NOTE: Use a separate form for each comment. Submittals (Microsoft Word preferred) may be attached to e-mail (preferred), or submitted in paper by mail or fax to ASHRAE, Senior Manager of Standards, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. [E-mail: change.proposal@ashrae.org](mailto:change.proposal@ashrae.org). Fax: +1-404-321-5478.

1. Submitter:

Affiliation:

Address: City: State: Zip: Country:

Telephone: Fax: E-Mail:

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Submitter's signature: _____ Date:

All electronic submittals must have the following statement completed:

I (*insert name*), through this electronic signature, hereby grant ASHRAE the non-exclusive royalty rights, including non-exclusive rights in copyright, in my proposals. I understand that I acquire no rights in publication of the standard in which my proposals in this or other analogous form is used. I hereby attest that I have the authority and am empowered to grant this copyright release.

2. Number and year of standard:

3. Page number and clause (section), subclause, or paragraph number:

4. ~~substitute as follows~~ **I propose to:** Change to read as follows Delete and
(check one) Add new text as follows Delete without substitution

Use underscores to show material to be added (added) and strike through material to be deleted (deleted). Use additional pages if needed.

5. Proposed change:

6. Reason and substantiation:

7. Will the proposed change increase the cost of engineering or construction? If yes, provide a brief explanation as to why the increase is justified.

Check if additional pages are attached. Number of additional pages: _____

Check if attachments or referenced materials cited in this proposal accompany this proposed change. Please verify that all attachments and references are relevant, current, and clearly labeled to avoid processing and review delays. *Please list your attachments here:*

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 · 1791 Tullie Circle NE · Atlanta, GA 30329 · www.ashrae.org

About ASHRAE

ASHRAE, founded in 1894, is a global society advancing human well-being through sustainable technology for the built environment. The Society and its members focus on building systems, energy efficiency, indoor air quality, refrigeration, and sustainability. Through research, Standards writing, publishing, certification and continuing education, ASHRAE shapes tomorrow's built environment today.

For more information or to become a member of ASHRAE, visit www.ashrae.org.

To stay current with this and other ASHRAE Standards and Guidelines, visit www.ashrae.org/standards. Visit

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ASHRAE offers its Standards and Guidelines in print, as immediately downloadable PDFs, on CD-ROM, and via ASHRAE Digital Collections, which provides online access with automatic updates as well as historical versions of publications. Selected Standards and Guidelines are also offered in redline versions that indicate the changes made between the active Standard or Guideline and its previous version. For more information, visit the Standards and Guidelines section of the ASHRAE Bookstore at www.ashrae.org/bookstore.

IMPORTANT NOTICES ABOUT THIS STANDARD

To ensure that you have all of the approved addenda, errata, and interpretations for this Standard, visit www.ashrae.org/standards to download them free of charge.

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