

STANDARD

ANSI/ASHRAE/ACCA Standard 211-2018

Standard for Commercial Building Energy Audits

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Cognizant TC: 7.06, Building Energy Performance
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NOTE

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FOREWORD

The commercial energy audit industry is largely unregulated, and products that are labeled “energy audits” vary greatly in scope, rigor, and quality. This standard is intended to bring some order to the chaos by establishing minimum performance levels for energy audits. ASHRAE’s Procedures for Commercial Building Energy Audits, Second Edition (aka, The Green Book, or PCBEA) helped define terms, and Audit Levels 1, 2, and 3 are now commonly used in the U.S. and abroad as a shorthand for audit scoping. However, this prior work was not written in code enforceable language, and PCBEA leaves much room for interpretation.

Standard 211 is intended to bring additional definition to the level descriptions within PCBEA. With an increasing number of mandatory energy audits required by cities around the U.S., and a critical need to reduce the energy footprint of our building stock, there is a need to more closely ensure that audits are held to the appropriate level of rigor and depth. Greater consistency in approach also promises lower costs if energy auditors can establish consistent reporting rather than use custom approaches that are often required by different contracting entities. The hope of the committee is that standardization may lead to greater efficiency and overall impact.

With the publication of this standard, there is overlap between the energy audit level definitions herein and the prior definitions that are part of the PCBEA. Standard 211 is intended to provide the new working definition of Energy Audit Levels 1, 2, and 3, and the PCBEA will be revised to address best practices. Revision of that publication has already begun.

Standard 211 adjusts the scope of the Preliminary Energy Use Analysis methods and Audit Levels 1, 2, and 3. Although both the PCBEA and Standard 211 refer to utility bill analysis as “Preliminary Energy Use Analysis” (PEA), Standard 211 considers PEA and benchmarking activity to be part of a Level 1 audit. Before, the Level 1 audit is less intensive than Level 2; therefore, the energy savings and costs of potential energy efficiency measures (EEMs) identified are intended to be qualitative in nature.

Before the development of this standard, even with the guidance provided in the PCBEA, energy audit levels did not have sharp boundaries. They existed, instead, as general categories for identifying the type of information that can be expected and as an indication of the level of confidence in the results; that is, various measures may be subjected to different levels of analysis during energy analysis of a particular building. Standard 211 provides more clarity to the differences between Level 1, 2, and 3 audits.

Beyond the three audit levels defined in this standard, simple benchmarking of energy performance is sometimes referred to as a “Level 0” audit. In recent years, other preliminary analyses such as “virtual” or “remote” energy audits, have become common. These have a role to play in initial screenings, but they should not be considered a replacement for an onsite energy audit by an experienced, qualified energy auditor.

The two primary intended uses of this standard are

- for building owners, as a means of specifying a defined scope for an energy audit of their facilities and for ensuring a common scope and level of rigor under contract or through a competitive bid, and
- for government agencies who require energy audits within their jurisdiction.

This standard attempts to serve the needs of each of these use cases at a minimum, though a broader application in the industry is expected. The standard is also intended as a minimum performance standard and not as a guideline for best practice. In many cases, best practice may go beyond the minimums required here.

The standard makes reference to “the Authority Having Jurisdiction (AHJ)” as the entity requiring compliance with the standard. It is intended that this term refer to either the government jurisdiction or the building owner, as applicable. The AHJ is expected to use the standard to suit their own objective and to modify the scope, procedures, and reporting as appropriate for their own goals and priorities.

The standard includes normative (required) reporting forms in Annex C. These forms are a compromise, in a sense, as many people and organizations have very different viewpoints as to what should be reported in an energy audit. The AHJ may choose to implement the standard using these forms, by modifying them or by explicitly opting out of their use, as they see fit. The forms are included in the standard for three principal reasons:

- They provide a minimum standardized reporting path to follow for local jurisdictions who do not have the resources to develop their own.
- They are designed to facilitate the use of electronic data transfer.
- They require important quality control checks on energy savings estimates.

This standard is the product of countless volunteer hours spent developing and refining it, and of numerous comments and suggestions during public review intended to improve its quality, consistency, and usability. These efforts represent a significant contribution toward reducing the energy consumption of our building stock. The committee is deeply grateful to everyone who offered their time and enthusiasm in service of this important mission.

1. PURPOSE

The purpose of this standard is to establish consistent practices for conducting and reporting energy audits for commercial buildings.

This standard

- defines the procedures required to perform Energy Audit Levels 1, 2, and 3;
- provides a common scope of work for these audit levels for use by building owners and others;
- establishes consistent methodology and minimum rigor of analysis required; and
- establishes minimum reporting requirements for the results of energy audits.

2. SCOPE

2.1 This standard applies to all buildings except single-family houses, multifamily structures of three stories or fewer above grade, manufactured houses (mobile homes), and manufactured houses (modular).

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 (AHJ).

authority having jurisdiction (AHJ): the agency or agency responsible for enforcing this standard.

base case: an operating scenario prior to consideration of energy efficiency measures (EEMs); used as a reference for evaluation of subject EEMs.

building energy: energy consumed by a building as measured at the boundaries of the building E_{bld} .

building energy model: model based on first-principles engineering methods that provides information on the energy-using systems in a building (heating, ventilation, and air conditioning; lighting; occupancy; plug loads; building envelope). The model, along with weather data, serves as the input data for a specific computer building energy simulation program. When run, the computer simulation program will estimate the energy use and demand in the described building for a time interval specified in the building energy model. Depending on the kind of simulation program and how it is set up to run, various kinds of output may be produced.

combined heat and power (CHP): simultaneous production of thermal and electric power; also referred to as “cogeneration.”

distributed energy resource (DER): the onsite production of electric power by any of a variety of technologies; may also include energy storage technologies.

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, demand, customer, power factor, and miscellaneous, such as sales taxes.

Energy Cost Index (ECI): the total annual energy cost for the building divided by the gross floor area.

energy efficiency measure (EEM): an action taken in the operation or equipment in a building that reduces energy use of the building while maintaining or enhancing the building’s safety, comfort, and functionality; also referred to as “energy conservation measure” (ECM).

energy use intensity (EUI): total annual building energy use divided by the gross floor area. The EUI may be expressed as a site energy EUI or a building energy EUI.

gross floor area: the sum of the floor areas of all the spaces within the building with no deductions for floor penetrations other than atria. It is measured from the exterior faces of exterior walls or from the centerline of walls separating buildings but it excludes covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, roof overhangs, parking garages, surface parking, and similar features.

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

life-cycle cost analysis: a general approach to economic evaluation that encompasses several related economic evaluation measures, including life-cycle cost (LCC), net benefits (NB) or net savings (NS), savings-to-investment ratio (SIR), net present value (NPV), and adjusted internal rate of return (AIRR), all of which take into account all dollar costs related to owning, operating, maintaining, and disposing of a project over the appropriate study period.

model: mathematical representation or calculation procedure used to estimate the energy used in a building or facility. Models may be based on equations that specifically represent the physical processes.

practical measure: an EEM that is determined to be technically feasible.

owner’s criteria: a set of criteria determined through communication between the owner or owner’s representative and the qualified energy auditor by which recommendations and findings are evaluated.

qualified energy auditor: an energy solutions professional who assesses building systems and site conditions; analyzes and evaluates equipment and energy use; and recommends strategies to optimize building resource use. Experience must include completion of five commercial (nonresidential) building energy audits within the past three years or a cumulative completion of ten or more commercial building energy audits. The auditor must be one of the following:

- A person who holds a certification from a credentialing program approved by the U.S. Department of Energy Better Buildings Workforce Guidelines for Building Energy Auditors or Energy Managers

- b. A licensed professional engineer or a licensed contractor specifically approved by the AHJ to conduct energy audits
- c. A person approved as qualified by the authority having jurisdiction (AHJ)

Informative Note: For a current listing of certifications that meet the requirements of the DOE's Better Building Workforce Guidelines, see the website referenced in Informative Annex H. Only credentialing programs that specifically certify building energy auditors or energy managers are applicable.

recommended measure: a practical measure that has been vetted for interactive effects with other practical measures and determined by the qualified energy auditor to provide net benefit to the building ownership. LCCA may be used as the methodology to filter practical measures to recommended measures.

renewable energy resource: a nonfossil-fuel energy source such as solar, wind, or geothermal energy. For purposes of this standard, consideration is to onsite opportunities for use of such sources.

simple payback: estimated initial EEM cost divided by the EEM first-year calculated cost savings. Both savings and costs are in dollars (\$) or other consistent monetary units, and the simple payback is expressed in years.

simple return on investment (simple ROI): the EEM first-year calculated cost savings divided by estimated initial EEM cost. Both savings and costs are in dollars (\$) or other consistent monetary units.

site energy: energy consumed by a building as measured at the boundaries of the building site E_{site} . Site energy use is the sum of annual electric use in kWh (converted to kBtu or MJ) and all other annual energy use (in kBtu or MJ). It includes fuel used for any onsite generation but not the output of that generation. Site energy use is net of onsite generation such as solar or wind.

Informative Note: More details about site energy and other energy consumption boundaries are included in ASHRAE Standard 105 and in Figure 1.

3.2 Abbreviations and Acronyms

AEE	Association of Energy Engineers
AHJ	authority having jurisdiction
BAS	building automation system
CBECS	Commercial Building Energy Consumption Survey
CHP	combined heat and power
DDC	direct digital control
DER	distributed energy resource
DOAS	dedicated outdoor air system
EUI	energy cost index
EEM	energy efficiency measure
EIA	Energy Information Administration
ERV	energy recovery ventilation

ESP	energy service provider
EUI	energy use intensity
HRV	heat recovery ventilation
HVAC	heating, ventilation, and air conditioning
IAQ	indoor air quality
IEQ	indoor environmental quality
IRR	internal rate of return
kBtu	1000 Btu
LCCA	life-cycle cost analysis
MBTU	1,000,000 Btu
O&M	operations and maintenance
PEA	Preliminary Energy Use Analysis
RER	renewable energy resource
ROI	return on investment
SHW/DHW	service hot water or domestic hot water, depending on building type or end use
VAV	variable air volume
VRF	variable refrigerant flow

4. COMPLIANCE REQUIREMENTS

4.1 Compliance

4.1.1 Compliance with the standard shall be certified by a qualified energy auditor using the compliance form in Normative Annex A. By signing and certifying the compliance form, the qualified energy auditor attests that the energy audit conforms to the methods and procedures of this standard and that the work was reviewed or completed, as required, by a qualified energy auditor.

5. PROCEDURES

5.1 Scope of Systems

5.1.1 The scope of the energy audit shall include the following systems, as applicable to the building:

- a. Envelope (including infiltration, exfiltration, and stack effect pathways)
- b. Lighting (interior and exterior)
- c. HVAC (cooling, heating, air distribution, ventilation and exhaust systems [including those to meet loads due to laundry and mail chutes])
- d. Building automation systems (BASs)
- e. Heating, chilled, condenser, and domestic water systems and associated pumps
- f. Steam systems
- g. Refrigeration (except for food processing refrigeration)
- h. Onsite power generation equipment, including renewable energy systems
- i. Uninterruptible power supplies, power distribution units, and critical power systems
- j. Data centers and information technology infrastructure
- k. Conveyance systems (escalators, elevators, baggage handling, moving sidewalks, and similar)

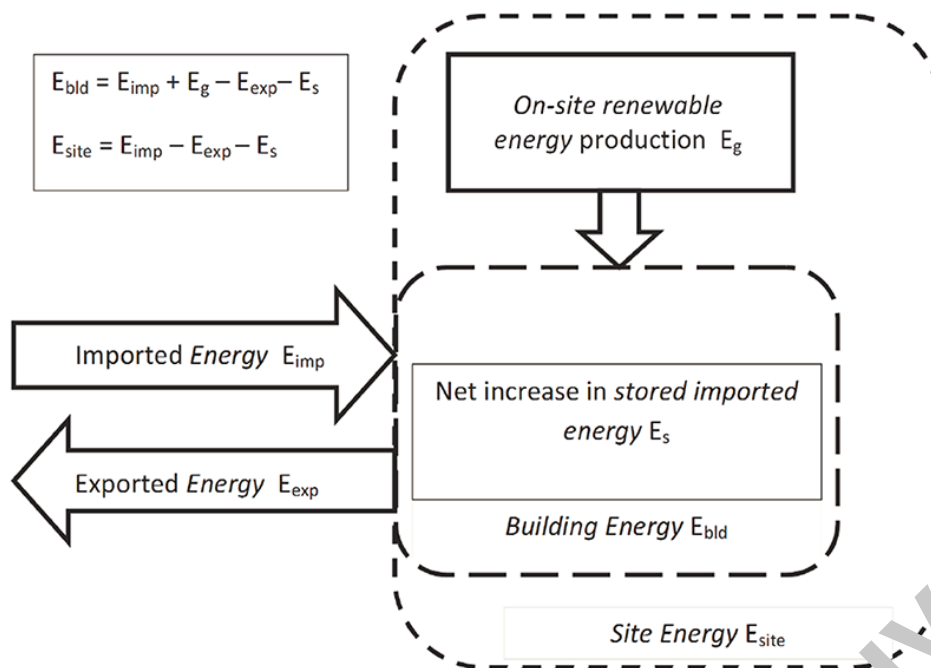


Figure 1 Relationship of site energy (E_{site}) and building energy (E_{bld}).

- l. Plug loads (including office equipment, personal computers, appliances)
- m. Laundries
- n. Food preparation
- o. Pools, saunas, and spas

The following end uses are not included in this standard:

- a. Industrial processes
- b. Agricultural processes
- c. Irrigation

5.2 General Procedures

5.2.1 Introduction. This standard defines three levels of energy audits: Levels 1, 2, and 3. Each successive level builds on the preceding levels, such that a Level 3 Audit includes all items that had already been required through a Level 1 audit and analysis. A Preliminary Energy Use Analysis (PEA) is included in the Level 1 audit.

5.2.2 Role of the Qualified Energy Auditor. The following activities must be completed by the qualified energy auditor to achieve compliance:

- a. Conduct a site visit for Levels 1, 2, and 3.
- b. Identify and qualify EEMs for Levels 1, 2, and 3.
- c. Conduct quality assurance for Levels 1, 2, and 3.
- d. Conduct risk assessment for Level 3.
- e. Present results to building owner for Levels 1, 2, and 3.
- f. Sign the compliance form.

The qualified energy auditor shall conduct or supervise the completion of all other required tasks as described in this standard.

5.2.3 Preliminary Energy Use Analysis (Benchmarking). Benchmark the building's normalized energy consumption relative to that of similar (peer) buildings using energy

consumption data spanning a minimum of 12 consecutive months and up to three consecutive years, as available. For buildings with multiple tenants, the sampling procedure described in Section 5.3.1.2 shall be applied.

Informative Note: Summary information about benchmarking energy use, based on 2003 CBECS data, is presented in the 2015 *ASHRAE Handbook—HVAC Applications*, Chapter 36, "Energy Use and Management." More recent 2012 CBECS data are published by the DOE Energy Information Administration. Additional data are available from ENERGY STAR Portfolio Manager, which compares measured energy data to that of a peer building (by building type and weather). Data specific to multifamily housing are available from 2009 RECS statistics or from EPMI.

5.2.3.1 Calculate the Energy Use Intensity. Calculate the total annual building energy use, either including or excluding onsite renewable energy, and divide by the gross floor area to obtain the energy use intensity (EUI). If the onsite renewable energy is included, the numerator is building energy E_{bld} . If onsite renewable energy is excluded, the numerator is site energy E_{site} . The choice of site or building energy must be documented as part of the audit report. Site and building energy are defined in Figure 1, as documented in ANSI/ASHRAE Standard 105¹, *Standard Methods of Determining, Expressing, and Comparing Building Energy Performance Greenhouse Gas Emissions*.

Informative Note: Building energy use includes imported energy such as electricity, natural gas, chilled water, steam, district hot water, propane, coal, compressed air, or any other source of supplied energy. These energy sources are included without regard for whether the energy is paid for by the building owner, tenant, operator, or other entity. Where estimates are made of energy data, the auditor shall state the reason why