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Standard Practice for Building Energy Performance Assessment for a Building Involved in a Real Estate Transaction[1]

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1. Scope

1.1 *Purpose*—The purpose of this standard is to define a commercially useful practice in the United States of America for conducting a *building energy performance assessment (BEPA)* on a building involved in a *commercial real estate transaction* and subsequent reporting of the *building energy performance* information. The practice is intended to provide a methodology to the *user* for the collection, compilation, analysis, and reporting of *building energy performance* information associated with a commercial building. The practice may be used independently or as a voluntary supplement to Guide E2018 for *property condition assessments* or Practice E1527 for Phase I *environmental site assessments*. Utilization of this practice and performance of a *BEPA* is voluntary. If the property *owner* (for example, the seller) is unwilling or unable to provide building *energy consumption* and cost information, a *BEPA* cannot be performed.

1.2 *Building Energy Performance*—This practice defines *building energy performance* as the building's total annual *energy consumption* and cost for heating, cooling, electricity, and other related uses. *Energy consumption*, for example, includes total electricity purchased; purchased or delivered steam, hot water, or chilled water; natural gas; fuel oil; coal; propane; biomass; or any other matter consumed as fuel and any electricity generated on site from *renewable/alternative* energy systems (for example, wind energy generator technology, fuel cells, microturbines or solar photovoltaic systems).

1.3 *Objectives*—Objectives in the development of this practice are to: *(1)* define a commercially useful practice for collecting, compiling, and analyzing *building energy performance* information associated with a building involved in a *commercial real estate transaction*; *(2)* facilitate consistency in the collection, compilation, analysis, and reporting of *building energy performance* information as may be required under building benchmarking, labeling, disclosure, or mandatory auditing regulations; *(3)* supplement as needed a *property condition assessment* conducted in accordance with Guide E2018 or an *environmental site assessment* conducted in accordance with Practice E1527; *(4)* provide that the process for *building energy performance* data collection, compilation, analysis, and reporting is consistent, transparent, practical and reasonable; and *(5)* provide an industry standard for the conduct of a *BEPA* on a building involved in a *commercial real estate transaction*, subject to existing statutes and regulations which may differ in terms of scope and practice.

1.4 *Documentation*—The scope of this practice includes data collection, compilation and reporting requirements. Documentation of all sources, records, and resources relied upon in the investigation is provided in the *report*.

1.5 *Considerations Outside the Scope*—The use of this practice is limited to the collection, compilation, and analysis of *building energy performance* information as defined by this practice for real estate transactions in the United States of America. While this information may be used to facilitate building benchmarking, labeling, rating or ranking, reporting of *building energy performance* information between a seller and a buyer or a landlord and a tenant on a voluntary basis or as may be required by building benchmarking, labeling, disclosure or mandatory auditing regulations applicable to the building, or any other use, such use is beyond the scope of this practice. This ASTM Standard Practice does not supersede existing statutes and regulations.

1.6 *Organization of This Practice*—This practice has 13 sections and 11 appendices. The appendices are included for informational purposes only and are not part of the procedures prescribed in this practice.

Section 1	Describes the scope of the practice.
Section 2	Identifies referenced documents.
Section 3	Provides terminology pertinent to the practice.
Section 4	Discusses the significance and use of the practice.
Section 5	Discusses the relationship between this practice and ASTM Guide E2018 or ASTM Practice E1527.
Section 6	Describes the *user's* responsibilities under this practice.
Section 7	Describes the *BEPA* process.
Section 8	Describes the *site visit* and *walk-through*.
Section 9	Discusses *interviews* with *owner*, *operator*, or *key site manager*.

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Section 10	Describes records collection for the *BEPA* process.
Section 11	Provides the records analysis methodology for building *energy consumption* data.
Section 12	Focuses on *BEPA report* preparation and reporting of building *energy consumption* information.
Section 13	Identifies non-scope considerations.
Appendix X1	Provides the legal background on federal, state, or local building *energy consumption* disclosure legislation and regulation.
Appendix X2	Identifies *building energy performance* and sustainability labeling programs.
Appendix X3	Discusses government and utility energy efficiency incentives and grants.
Appendix X4	Provides guidance on suggested qualifications for the *consultant* conducting the *BEPA*.
Appendix X5	Information that can be collected from the property *owner*/*operator*/*key site manager*.
Appendix X6	Provides a recommended table of contents and report format for the *BEPA*.
Appendix X7	Provides general property types with categories and subcategories that can impact building *energy consumption*.
Appendix X8	Provides a general commercial building survey checklist.
Appendix X9	Presents carbon emission estimation methodology associated with combustion processes related to *energy consumption* in a commercial building.
Appendix X10	Provides common no-cost/low-cost energy saving measures for commercial buildings.
Appendix X11	Provides illustrative example of building *site energy consumption* calculations.

1.7 *Units*—The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.8 *This practice cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard practice is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this practice be applied without consideration of a building's many unique aspects. The word "standard" in the title means only that the practice has been approved through the ASTM consensus process.*

1.9 *Nothing in this practice is intended to create or imply the existence of a legal obligation for reporting of energy, performance, or other building-related information. Any consideration of whether such an obligation exists under any federal, state, local, or common law is beyond the scope of this practice.*

1.10 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.11 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1527 Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process

E2018 Guide for Property Condition Assessments: Baseline Property Condition Assessment Process

2.2 *Other Standards:*[3]

ASHRAE, 2011, Procedures for Commercial Building Energy Audits, Second Edition

ASHRAE, 2012, Performance Measurement Protocols for Commercial Buildings: Best Practices Guide

ASHRAE Building Energy Quotient, www.ashrae.org/buildingEQ

ASHRAE Standard 211-2018, Standard for Commercial Building Energy Audits

ANSI/ASHRAE Standard 105-2014 Standard Method of Determining, Expressing and Comparing Building Energy Performance and Greenhouse Gas Emissions

DSIRE Database of Federal, State, Local Government and Utility Incentives for Renewable Energy and Energy Efficiency (http://www.dsireusa.org)

ISO 52000-1:2017, Energy Performance of Buildings

3. Terminology

3.1 *Definitions*—This section provides definitions and descriptions of terms used in this practice, terms used in this practice extracted from Practice E1527 and Guide E2018, and a list of acronyms for keywords used in this practice. The terms are an integral part of this practice and are critical to an understanding of the practice and its use.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *appropriate reporting, n*—represents a standardized way to report *building energy performance* information collected in accordance with and under the specific conditions identified in this practice to parties including, but not limited to, prospective purchasers, *owner*s, property managers, lenders, tenants, investors, or others, including government or regulatory entities, that may request such information.

3.2.2 *building energy performance, n*—a building's total annual *energy consumption* and cost for electricity and fuel used for heating, cooling and other energy-related uses.

3.2.3 *building energy performance assessment, BEPA, n*—the process as described in this practice by which a person or entity collects, analyzes and reports on the *energy consumption* and energy cost associated with a building. The output from the process is the *pro forma building energy consumption* and the *pro forma building energy cost*, which are considered

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, http://www.ashrae.org.

representative for the building at the time the assessment is performed. Also provided is a reasonable range for building *energy consumption* and energy cost. Finally, the process provides the actual building *energy consumption* and cost over the time period included in the investigation. A *BEPA* is based upon data collected over the prior three years, or back to the last *major renovation* if completed less than three years ago, with one year minimum. If acceptable data is not available for the minimum of one year, a *BEPA* cannot be conducted as prescribed in this standard.

3.2.4 *commercial real estate, n*—improved real property, except a dwelling or property with four or less dwelling units exclusively for residential use. The term includes, but is not limited to, improved real property used for retail, office, industrial, hospitality, agricultural, or other commercial, medical or educational purposes; property used for residential purposes that has more than four residential dwelling units; and property with four or less dwelling units for residential use when it has a commercial function, as in the construction of such dwellings for profit. (Refer to Practice E1527.)

3.2.5 *commercial real estate transaction, n*—a transfer of title to or possession of commercial real estate, rental of space in commercial real estate under a lease for a set period of time in return for consideration, a transfer of a leasehold interest in commercial real estate, or receipt of a security interest in commercial real estate, except that it does not include such transactions with respect to an individual dwelling, or a building containing four or less dwelling units, unless used for commercial purposes such as the operation of such dwellings for profit. (Refer to Practice E1527.)

3.2.6 *cooling degree-days (CDD), n*—for each day with an average temperature higher than 65 °F (18.3 °C), *CDD* is the difference between the average temperature and 65 °F (18.3 °C). For example, on a day with a mean temperature of 80 °F (26.6 °C), 15 *CDD* would be recorded. *CDD* data by month and region is published by the Energy Information Administration. *CDD* historical data by month and region is published by the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service Climate Prediction Center, Camp Springs, MD for 200 major weather stations around the country, and by others, including NOAA's National Climatic Data Center in Ashville, NC. Information is also available at http://www.degreedays.net.

3.2.7 *data gap, n*—lack of or inability to obtain information required by this practice despite *good faith* efforts by the person or entity seeking to gather such information. Data gaps may result from incompleteness in any of the activities required by this practice, including, but not limited to the collection of records data (for example, an inability to collect *energy consumption* data back three years, or to the last *major renovation* if it occurred less than three years ago, or a minimum of one year's data), and *interviews* (for example, an inability to interview the key site manager, and so forth). (Refer to Practice E1527.)

3.2.8 *district energy, n*—is *secondary energy* that is generated off site and delivered to a facility in the form of steam, hot water, or chilled water.

3.2.9 *easily visible, adj*—describes *observations* of items, components and systems that are conspicuous, apparent, and obvious during the *walk-through* without: intrusion, relocation or removal of materials, exploratory probing, use of special protective clothing, or use of any equipment (such as hand tools, meters of any kind, ladders, and so forth). (Refer to Guide E2018.)

3.2.10 *energy consumption, n*—total quantity of energy applied to a site, a facility, or a building for powering and sustaining all end-uses including energy generated by renewable sources. Such energy may include electricity, natural gas, heating oil, district steam, district hot water, district cooling water, propane, and so forth, used by a facility for heating, cooling, ventilation, lighting, or powering other end uses in a building, with energy generated by *renewable energy sources* such as solar, wind or fuel cells separately identified (as these may be netted out when determining building *energy consumption*). The units of total building *energy consumption* are typically in thousand of Btu per year (kBtu/yr). *Energy consumption* as described in this practice refers to *site energy consumption*.

3.2.11 *energy consumption equation, n*—relates the dependent variable, a building's total *site energy consumption*, including electricity and on-site fuel/district *energy consumption*, to independent variables whose variability is known to impact materially a building's *energy consumption*. Independent variables may, for example, include weather conditions (*HDD* and *CDD*), operating hours for the building, *occupancy* (or *vacancy*) rate, and number of *occupants*. Independent variables may also include any other variables judged to have a material influence on building *energy consumption* and deemed by the *BEPA consultant* to be available, appropriate, and relevant for the analysis. The *energy consumption equation* for a building may be calculated for a building's total *energy consumption*, for example, combined electricity and fuel, or separately for the building's electricity use and for the building's fuel use.

3.2.12 *energy consumption intensity (ECI), n*—total building *energy consumption* divided by the building's *gross floor area*. The units of building *energy consumption intensity* are typically kBtu/SF-yr. *ECI* is associated with a building of a specific property type with specific characteristics or other factors that may facilitate comparison with similar type buildings with similar characteristics (see Appendix X7 for a sample checklist of building characteristics that can impact *energy consumption* associated with select building types). *ECI* as described in this practice is determined on a *site energy consumption* basis. *Energy consumption intensity* has also been referred to as *energy consumption intensity* (EUI).

3.2.13 *environmental site assessment (ESA), n*—process by which a person or entity observes a property, interviews knowledgeable *owner*s or *operator*s and state regulatory personnel, collects and reviews *reasonably ascertainable* government and historical property records for the purpose of identifying if a recognized environmental condition exists at the property. The *ESA* process is detailed in Practice E1527.

3.2.14 *good faith, n*—absence of any intention to seek an unfair advantage or to defraud another party; an honest and sincere intention to fulfill one's obligations in the conduct of a transaction. (Refer to Practice E1527.)

3.2.15 *gross floor area (GFA), n*—area on all floor levels within the perimeter of the outside walls of a building as measured from the inside surface of the exterior walls, with no deduction for hallways, stairs, closets, columns, or other interior features, excluding parking area. *Gross floor area* is distinguished from the leasable or rentable area, which is the occupied area on all floor levels for which a tenant is charged for *occupancy* under a lease. Leasable area may exclude common areas (such as lobbies and foyers, stairways and elevators, corridors and passages, mechanical rooms, rest rooms, and so forth). Only *gross floor area* is used in the energy metrics associated with this practice, for example, in the determination of *energy consumption intensity*.

3.2.16 *heating degree-days (HDD), n*—for each day with an average temperature lower than 65°F (18.3°C), *HDD* is the difference between the average temperature and 65°F (18.3°C). For example, on a day with a mean temperature of 40°F (4.4°C), 25 *HDD* would be recorded. *HDD* data by month and region is published by the Energy Information Administration. *HDD* historical data by month and region is published by NOAA's National Weather Service Climate Prediction Center, Camp Springs, MD for 200 major weather stations around the country, and by others, including NOAA's National Climatic Data Center in Ashville, NC. Information is also available at http://www.degreedays.net.

3.2.17 *heating value, n*—amount of heat produced by the complete combustion of a unit quantity of fuel. For the purposes of this practice, higher heating value (HHV) is used to convert the quantity of fuel to its energy content.

3.2.18 *interviews, n*—discussions with those knowledgeable about the property. (Refer to Guide E2018.)

3.2.19 *key site manager, n*—person identified by the *owner* or *operator* of a property as having knowledge of the physical and operational characteristics of the building or buildings on a property. (Refer to Practice E1527.)

3.2.20 *lower limit scenario, n*—with respect to building *energy consumption* or *ECI*, a reasonable lower limit for *energy consumption* or *ECI* at the building (see subsection 11.4.1.4). The lower limit scenario is determined using the 25th percentile for *HDD*, *CDD* and all other independent variables in the building *energy consumption equation*.

3.2.21 *major renovation, n*—building renovation that either involves expansion (or reduction) of the building's *gross floor area* by 10 % or more or impacts total building *energy consumption* by more than 10 %.

3.2.22 *normalize, v*—to reduce to a norm, such as normalizing building *energy consumption* by removing the influence of weather or building *gross floor area* or other conditions (referred to as normalizing factors). For example, to normalize a building's *energy consumption* (in kBtu/yr) using the building's *gross floor area* (in square feet), divide building *energy consumption* by the gross floor area. The resulting normalized quotient is in units of kBtu/SF-yr, also referred to as the *energy consumption intensity*.

3.2.23 *observation, n*—visual note of specific items, systems, conditions, or components that are observed during a *walk-through*. (Refer to Guide E2018.)

3.2.24 *occupancy, n*—occupied tenant space in a building. The *occupancy* rate generally refers to the occupied space in a building divided by the total space available to be occupied, generally represented as a percentage. Leased space is not always occupied space, as the tenant may have left the space, but may still be paying the monthly lease cost under terms of the lease agreement.

3.2.25 *occupants, n*—those tenants, subtenants, or other persons or entities using the property or a portion of the property. (Refer to Practice E1527.)

3.2.26 *operator, n*—person responsible for, or the designated representative of the organization responsible for the overall operation of a property. (Refer to Practice E1527.)

3.2.27 *owner, n*—generally the fee *owner* of record of the property. (Refer to Practice E1527.)

3.2.28 *practically reviewable, adj*—information that is provided by the source in a manner and in a form that, upon examination, yields information relevant to the property without the need for extraordinary analysis of irrelevant data. (Refer to Practice E1527.)

3.2.29 *primary energy, n*—raw fuel, such as natural gas or fuel oil, that is burned on site at a building to create heat and/or electricity.

3.2.30 *pro forma building energy consumption, n*—building *energy consumption* (e.g., kBtu) determined from the *energy consumption equation* using the mean values for the independent variables, or the trailing twelve months of building *energy consumption* data if the independent variables identified in subsection 11.4.1 are within 15 % of the mean. *Pro forma building energy consumption* is considered representative of annual building *energy consumption* at the time of the *commercial real estate transaction* and is sometimes referred to as normalized building *energy consumption*. *Pro forma building energy consumption* is designed to reduce the influence [on building *energy consumption*] of biases such as unusual weather conditions (for example, an unusually warm winter or cool summer) or unusual building operational conditions (for example, an unusually high *vacancy* rate), etc.

3.2.31 *pro forma building energy consumption intensity, n*—building *energy consumption* intensity (e.g., kBtu/SF) determined from the *energy consumption* equation using the mean values for the independent variables, or the trailing twelve months of building *energy consumption intensity* data if the independent variables identified in subsection 11.4.1 are within 15 % of the mean. *Pro forma building energy consumption intensity* is considered representative of annual building *energy consumption intensity* at the time of the *commercial real estate transaction* and is sometimes referred to as the normalized building *energy consumption intensity*. *Pro forma building energy consumption intensity* is designed to reduce the influence [on building *energy consumption intensity*] of biases such

as unusual weather conditions (for example, an unusually warm winter or cool summer) or unusual building operational conditions (for example, an unusually high *vacancy* rate), etc.

3.2.32 *pro forma building energy cost, n*—obtained by dividing actual trailing 12 month total cost ($) associated with each energy source used at the building by the associated *energy consumption* of the source (kBtu/yr), and then summing these values to get the total trailing 12 month building energy cost multiplier ($/kBtu/yr). The total trailing 12 month building energy cost multiplier is then multiplied by the average case scenario for annual *site energy consumption* (see subsection 11.4.1.4*(1)*). *Pro forma building energy cost* is considered representative of average annual building energy cost at the time of the *commercial real estate transaction*. *Pro forma building energy cost* is designed to reduce the influence [on building energy cost] of biases such as unusual weather conditions (for example, an unusually warm winter or cool summer) or unusual building operational conditions (for example, an unusually high *vacancy* rate), etc. *Pro forma building energy cost* may also be determined on square foot (*gross floor area*) basis.

3.2.33 *property condition assessment, n*—process by which a person or entity observes a property, interviews sources, and reviews available documentation for the purpose of developing an opinion about a property's current physical condition. A *property condition assessment* is detailed in Guide E2018.

3.2.34 *qualified consultant or individual, n*—person having the education, training, and experience necessary for the conduct of this practice (see also Appendix X4). The person may be an independent contractor or an employee of the *user*.

3.2.35 *real estate transaction, n*—transfer of title to or possession of real estate, rental of space in real estate under a lease for a set period of time in return for consideration, a transfer of a leasehold interesting real estate, or receipt of a security interest in real estate.

3.2.36 *reasonably ascertainable, adj*—information that is *readily available*, *practically reviewable*, and available at a nominal cost for retrieval, reproduction, or forwarding. (Refer to Practice E1527.)

3.2.37 *readily accessible, adj*—describes *easily visible* areas of a property that are promptly made available for *observation* by the *qualified consultant or individual* conducting the *walk-through* and do not require removal or relocation of materials or personal property, such as furniture, floor, wall, or ceiling coverings; and that are safely accessible. (Refer to Guide E2018.)

3.2.38 *readily available, adv*—describes information or records that are easily and promptly provided by a source to the individual making a request through an appropriate inquiry and without the need to research archive files. (Refer to Practice E1527.)

3.2.39 *renewable energy, n*—means a source of energy that occurs naturally or is regenerated naturally, including, without limitation: *(a)* Biomass; *(b)* Fuel cells; *(c)* Geothermal energy; *(d)* Solar energy; *(e)* Waste heat (such as produced in a combined heat and power system); *(f)* Waterpower (hydro); and *(g)* Wind.

3.2.39.1 *Discussion*—The term does not include coal, natural gas, oil, propane or any other fossil fuel, or nuclear energy. *Renewable energy* systems may also be referred to as alternative energy systems.

3.2.40 *report, n*—written information prepared by a *qualified consultant or individual* and constituting an integral part of a *Building Energy Performance Assessment* as required by this practice.

3.2.41 *reporting period*—the period over which the amount of building *energy consumption* and costs are evaluated after the installation of energy conservation and/or *renewable energy* measures.

3.2.42 *secondary energy, n*—energy product (heat or electricity) created from a raw fuel, such as electricity purchased from the grid or energy (heat or cooling) received from a district system.

3.2.43 *site energy consumption, n*—amount of heat and electricity consumed by a building as reflected in its utility/energy bills or on-site generation or both, if any. *Site energy consumption* may also be referred to as building *energy consumption*. *Site energy* may be delivered to a building in one of two forms: *primary energy* or *secondary energy* or both. *Energy consumption* and the methodology developed in this practice are based upon *site energy consumption*.

3.2.43.1 *Discussion—Site energy consumption* is different from source *energy consumption*. Source *energy consumption* represents the total amount of raw fuel that is required to meet a building's energy needs and incorporates transmission, delivery, and production losses at/from the source (such as the local power plant). While source energy is not specifically used in the methodology associated with this practice, it is used by U.S. EPA to determine a building's greenhouse gas (carbon) emissions associated with combustion processes (refer to Appendix X9).

3.2.44 *site visit, n*—that part of the practice contained in Section 8 during which the *qualified consultant's* or *individual's walk-through* of the property takes place.

3.2.45 *total energy consumption, n*—sum of all energy consumed in the building, including purchased energy plus energy consumed on-site. Energy produced by the *renewable energy* systems is identified separately and may be netted out from building *total energy consumption*.

3.2.46 *upper limit scenario, n*—with respect to building *energy consumption* or *ECI*, a reasonable upper limit for *energy consumption* or *ECI* at the building (see subsection 11.4.1.4). The upper limit scenario is determined using the 75th percentile for *HDD*, *CDD*, and all other independent variables used in the building *energy consumption equation*.

3.2.47 *user, n*—party seeking to use this practice to complete a *building energy performance assessment*. A *user* may include, without limitation, a potential purchaser of the property, a potential tenant of the property, an *owner* of the property, a lender or a property manager.

3.2.48 *utility-energy bills/utility-energy data, n*—invoices from companies that provide energy to a building, including utility/energy companies, such as those that provide electricity,

natural gas, district steam, district hot water, or district chilled water to a property, and companies that deliver oil, propane, kerosene, coal, coke, wood, or other fuels used at the building.

3.2.49 *vacancy, n*—empty or unoccupied tenant space in a building. The *vacancy* rate generally refers to the empty or unoccupied space in a building divided by the total space available to be occupied, generally represented as a percentage. If a tenant has left a space but still continues to pay rent on the vacated space in accordance with his or her lease obligation, the space is considered vacant for the purposes of this practice.

3.2.50 *walk-through, n*—conducted during the *site visit* consisting of *easily visible observation*s of readily accessible major building components and systems that can impact building *energy consumption*.

3.3 *Acronyms and Abbreviations:*

3.3.1 *ASHRAE*—American Society of Heating, Refrigerating and Air-Conditioning Engineers

3.3.2 *ASTM*—ASTM International

3.3.3 *BEPA—Building energy performance assessment*

3.3.4 *BTU*—British thermal units

3.3.5 *CDD*—Cooling degree days

3.3.6 *ECI—Energy consumption intensity* (typically in units of kBtu/SF)

3.3.7 *ECM*—Energy conservation measure

3.3.8 *EPA*—U.S. Environmental Protection Agency

3.3.9 *ESA—Environmental site assessment*

3.3.10 *GFA*—Gross floor area associated with a building

3.3.11 *GHG*—Greenhouse gas

3.3.12 *GWh*—Gigawatt (10^9 Watt) hour

3.3.13 *HDD*—Heating degree days

3.3.14 *HHV*—Higher *heating value*

3.3.15 *HVAC*—Heating, ventilation, and air conditioning

3.3.16 *kBtu*—Kilo (10^3) British thermal units (Btu)

3.3.17 *kW*—kilowatt (10^3 Watt)

3.3.18 *kWh*—kilowatt (10^3 Watt) hour

3.3.19 *MBtu*—million (10^6) British thermal units (Btu)

3.3.20 *MWh*—megawatt (10^6 watt) hour

3.3.21 *NERC*—North America Electric Reliability Council

3.3.22 *NOAA*—National Oceanic and Atmospheric Administration

3.3.23 *NOI*—Net operating income

3.3.24 *OCC*—Occupancy

3.3.25 *PCA—Property condition assessment*

3.3.26 *ROI*—Return on investment

3.3.27 *SF*—Square foot [gross square feet of building]

4. Significance and Use

4.1 *Uses*—This practice is intended for use on a voluntary basis by parties who wish to conduct a *BEPA* on a building. The process defined in this practice involves the collection of building *energy consumption* information, some of which may be collected as part of E2018 *PCA* or E1527 *ESA*. The practice is intended primarily as an approach to conducting a standardized inquiry designed to identify representative *building energy performance* in connection with a commercial property involved in a *real estate transaction*. This practice is intended to reflect a commercially practical and reasonable inquiry.

4.1.1 A number of states including CA, CO, WA and NJ, and more than three dozen cities, county and municipal governments, including Ann Arbor, MI, Atlanta, GA, Austin, TX, Berkeley, CA, Bloomington, MN, Boston, MA, Boulder, CO, Cambridge, MA, Chicago, IL, Chula Vista, CA, Columbus, OH, Denver, CO, Des Moines, IA, Edina, MN, Evanston, IL, Fort Collins, CO, Indianapolis, IN, Kansas City, MO, Los Angeles, CA, Miami, FL, Minneapolis, MN, Montgomery County, MD, New York City, NY, Orlando, FL, Philadelphia, PA, Pittsburgh, PA, Portland, ME, Portland, OR, Reno, NV, Salt Lake City, UT, San Diego, CA, San Francisco, CA, San Jose, CA, Seattle, WA, South Portland, ME, St. Louis, MO, St. Louis Park, MN, St. Paul, MN and Washington, D.C. have building energy performance benchmarking and reporting policies. *Users* in these locations must comply with applicable ordinances and regulations.

4.2 *Clarifications on Use:*

4.2.1 *Use in Conjunction with E2018 PCA or E1527 ESA*—This practice, when added as a supplemental scope of work to a E2018 *PCA* or a E1527 *ESA*, is designed to assist the *user* and *consultant* in developing information about *energy consumption* in a building or buildings involved in a *real estate transaction*. The *BEPA* also has utility to a wide range of persons, including those who may not be involved in a *real estate transaction*.

4.2.2 *Independent Use*—This practice may also be used independently of any other building assessment to determine *building energy performance*.

4.2.3 *Site-Specific*—This practice is property-specific in that it relates to existing *building energy performance*. The practice is not intended to replace E2018 *PCA* or E1527 *ESA* conducted by a *qualified consultant* or *individual*, but rather to supplement it.

4.3 *Who May Conduct*—A *BEPA* shall be performed by a *qualified consultant* or *individual* (hereafter referred to as the "*Consultant*") with the education, training and experience necessary to perform the requirements of this practice (see Appendix X4). No practical approach can be designed to eliminate the role of professional judgment and the value and need for experience in the individual performing the inquiry. The professional experience of the *Consultant* is, consequently, important to the performance of this *BEPA*.

4.4 *Additional Services*—As set forth in Section 13, additional services may be contracted for between the *user* and the *Consultant*. Such additional services may include issues not included within the scope of this practice. For example, the *user* or *Consultant* may wish to benchmark the building against similar buildings in the portfolio or in the same geographical area or identify select green building attributes that may contribute to the energy efficiency performance and/or the building's valuation.

4.4.1 *Benchmarking Additional Service*—Any benchmarking system selected relies on critical data in generating its output, so the validity of the data collection process directly impacts the integrity and usefulness of the benchmarking system's results. Utilization of this practice and adoption of its data collection approach can serve to enhance the integrity of

the benchmarking process for all transactional stakeholders in a standardized, fully transparent, uniform, and consistent manner. Notwithstanding, building *energy consumption* information should always be evaluated within the context in which it is collected and building *energy consumption* numbers should not be used without conveying this context. (Refer to Appendix X1 for additional information.)

4.5 *Principles*—The following principles are an integral part of this practice and are intended to be referred to in resolving any ambiguity or exercising such discretion as is accorded the *user* or *Consultant* in performing a *BEPA*.

4.5.1 *Uncertainty Not Eliminated in BEPA*—No *BEPA* practice can wholly eliminate uncertainty in determining the myriad of variables that can impact the *energy consumption* of a building on a property. The *BEPA* is intended to reduce, but not eliminate, uncertainty regarding the impact such variables can have on the *energy consumption* of a building.

4.5.2 *Not Exhaustive*—This practice is not meant to be an exhaustive assessment. There is a point at which the cost of information obtained or the time required to gather it outweighs the usefulness of the information and, in fact, may be a material detriment to the orderly completion of a *real estate transaction*. One of the purposes of this practice is to identify a balance between the competing goals of limiting the costs and time demands inherent in performing a *BEPA* and the reduction of uncertainty about unknown conditions resulting from collecting additional information.

4.5.3 *Level of Inquiry is Variable*—Not every building will warrant the same level of assessment. The appropriate level of assessment will be guided by the type of property subject to assessment and its complexity, the needs of the *user*, and the information already available or developed in the course of the inquiry.

4.6 *Rules of Engagement*—The contractual and legal obligations between a *Consultant* and a *user* (and other parties, if any) are outside the scope of this practice. No specific legal relationship between the *Consultant* and *user* was considered during the preparation of this practice.

5. Relationship to E2018 *PCA* and E1527 *ESA*

5.1 *Building Energy Performance Data Collected in Guide E2018*—ASTM Guide E2018 is directed principally at the physical status of a building and associated property, including the building's structure, electrical and mechanical systems, heating, ventilation and air conditioning systems (HVAC), roofing and plumbing systems, code compliance, parking lot, and sidewalk physical condition, with the objective of identifying deficiencies and the associated probable cost to remedy these deficiencies. While Guide E2018 does include identification of utilities provided to the property for heating, ventilation, and cooling equipment and other energy-related uses, it does not include the collection of building *energy consumption* information. This practice is intended to supplement Guide E2018 when a *user* requests that *building energy performance* information be included in the *PCA*.

5.2 *Building Energy Performance Data Collected in Practice E1527*—ASTM Practice E1527 is directed principally at the environmental condition of the property, including whether known or suspect environmental contamination is associated with the property. Building *energy consumption* can impact the environment by directly or indirectly contributing to carbon emissions that may contribute to climate change. While Practice E1527 includes a building *walk-through*, interviews with key site personnel and collection of select building characteristics, it does not include the collection of building *energy consumption* information. This practice is intended to supplement Practice E1527 when a *user* requests that *building energy performance* information be included in the *ESA*.

5.3 *BEPA*—This practice is intended to be used independently or as a supplement to E2018 *PCA* or E1527 *ESA*.

5.3.1 The *BEPA* may be conducted concurrently with E2018 *PCA* or E1527 *ESA*.

5.3.2 The *BEPA* may be conducted independently of E2018 *PCA* or E1527 *ESA*. When conducting a *BEPA* independent of E2018 *PCA* or E1527 *ESA*, the data requirements specified in this practice shall be collected.

6. User Responsibilities

6.1 *Scope*—The purpose of this section is to describe tasks to be performed by the *user* that will assist the *Consultant* conducting the *BEPA* on a building connected to a *real estate transaction*. These tasks do not require the technical expertise of a *Consultant* and are generally not performed by *Consultants* performing a *PCA* or *ESA*, unless directed to do so by the *user*. In a *real estate transaction*, it is common for the *user* to be the prospective property purchaser (the buyer), with the *Consultant* working for this *user*. The *user* may also be an existing or prospective tenant at the property.

6.1.1 *Discussion*—Notwithstanding, the relevant information about the building is best obtained from the property *owner* (the seller), or *operator*, and/or *key site manager*. As such, it is not unusual to find the *user* requesting information directly from the seller, with the understanding that such person is under no legal obligation to provide the information. It is also not unusual to find the *user* requesting the *Consultant* to obtain the information needed directly from the seller (that is, as part of the *PCA* or *ESA* process). If the property *owner* (e.g., seller) is unwilling to provide building *energy consumption* and cost information, a *BEPA* cannot be performed. Appendix X5 provides a sample of information that may be collected from the property *owner*, *operator* or *key site manager* and which can assist the *user* and/or the *Consultant* gathering information on the building that may be material to the *BEPA* in connection with the *real estate transaction*.

6.2 *Specialized Knowledge or Experience of the User*—If the *user* has any specialized knowledge or experience that is material to the *BEPA* in connection with the building, it is the *user's* responsibility to communicate any information based on such specialized knowledge or experience to the *Consultant* before the *Consultant* conducts the *BEPA*.

6.3 *Non-responsiveness*—If the *user* is unable to obtain the information requested directly from the property *owner* (or seller in a *real estate transaction*) or a designated representative, the *user* shall request authorization from the

property *owner* for the *Consultant* to collect the information, if available, through an interview process with the property *manager*, *operator*, and/or the *key site manager*, and/or through a request to the responsible utility or energy provider or both. If the property *owner* (e.g., seller) is unwilling to provide building *energy consumption* and cost information, a *BEPA* cannot be performed.

6.4 *Other*—Either the *user* shall make known to the *Consultant* the reason why the *user* wants to have the *BEPA* performed (such as, for example, to meet a regulatory requirement or a financing requirement or a due diligence requirement) or, if the *user* does not identify the purpose of the *BEPA*, the *Consultant* shall assume the purpose is to evaluate *building energy performance* for the *user*. The *user* and the *Consultant* may also need to modify the scope of services performed under this practice for special circumstances, including, but not limited to, unique local or site-specific conditions.

6.5 *Non-existent Legal Obligation—Nothing in this practice is intended to create or imply the existence of a legal obligation for reporting of building energy performance or other building-related information. Any consideration of whether such an obligation exists under any federal, state, local or common law is beyond the scope of this practice.*

7. Building Energy Performance Assessment (BEPA) Process

7.1 *Objective*—The purpose of the *BEPA* described in this practice is to identify, to the extent feasible pursuant to the processes prescribed herein, *building energy performance* in connection with a *commercial real estate transaction*. Such *building energy performance* shall include: *(1)* historical *building energy performance* over the previous three years, with a minimum of one year, or back to the last building *major renovation* (if completed less than three years ago); *(2)* the range of building *energy consumption* and cost under average, upper limit and lower limit scenarios as defined in this practice (see subsection 11.4.1.4); *(3)* the *pro forma building energy consumption* and *pro forma building energy cost* (see subsections 11.5 and 11.6); and *(4) appropriate reporting* of building *energy consumption* and cost information to the *user* or other *user*-designated parties. The *BEPA* process described in this practice is intended to be used independently, or to supplement but not replace existing E2018 *PCA* or E1527 *ESA*.

7.2 *Report*—A separate *report* shall be prepared, unless the *BEPA* is being performed as part of an E2018 *PCA* or E1527 *ESA* conducted on a property connected to a *commercial real estate transaction*, in which case the *BEPA* findings and conclusions can be provided in the *PCA* or *ESA report*.

7.2.1 *Components*—A *BEPA* shall have five components described as follows:

7.2.1.1 *Site visit*—To observe the building during the *walk-through*, conduct *interviews* (see 7.2.1.2), and collect records (see 7.2.1.3) not previously provided to the *Consultant*; see Section 8.

7.2.1.2 *Interviews*—With the present *owner*, *operator*, and/or *key site manager* at the building; see Section 9.

7.2.1.3 *Records collection*—Collect and compile the records necessary to conduct the *BEPA*; see Section 10.

7.2.1.4 *Records review and analysis*—Review and analysis of records necessary to conduct the *BEPA*; see Section 11.

7.2.1.5 *Report*—On the findings related to building *energy consumption* and energy cost; see Section 12.

7.3 *Coordination of Parts:*

7.3.1 *Parts Used in Concert*—Data collected are intended to be used in concert with each other. If information from one source (for example, the records received) indicates the need for more information, other sources (for example, the *interviews*) may be available to provide this information.

7.3.2 *User's Obligations*—The *Consultant* shall note in the *report* whether or not the *user* has provided the *Consultant* with information pursuant to Section 6 of this practice.

7.4 *Consultant Conducting a BEPA:*

7.4.1 *Consultant's Duties*—The *BEPA* shall be performed by a *qualified Consultant* or *individual* (the "*Consultant*") or performed by others under the supervision of the *Consultant*. This can be the same individual(s) responsible for conducting the E2018 *PCA* or E1527 *ESA*. The assessment shall be performed by a person possessing sufficient knowledge, training, and experience necessary to conduct the site *walk-through*, *interviews*, data collection, and analysis defined in this practice and having the ability to identify issues relevant to *building energy performance* in connection with a building involved in a *real estate transaction*. At a minimum, the *Consultant* shall be involved in planning the assessment and the review and interpretation of the information upon which the *BEPA report* is based. Appendix X4 provides suggested qualifications for the *Consultant* responsible for conducting the *BEPA*.

7.4.2 *Information Obtained From Others*—Information for the records review needed for completion of a *BEPA* may be provided by a number of parties including the *user* or a designated representative; the building *owner*, *operator*, or *key site manager*; the local utility or energy provider; government agencies; or third-party vendors.

7.5 *Applicable Property Types for a BEPA*—A *BEPA* as described in this practice is appropriate for property where utility/energy costs are centralized and paid by the property *owner*, *manager*, or *operator* and may include, but are not limited to, office, retail, hotel/lodging, warehouse, multifamily and industrial properties. If *energy consumption* is not centralized such as in individual, separately metered units at multifamily-type properties or in separately metered tenant spaces at commercial office or retail buildings where energy costs are individually paid for by tenants, a *BEPA* as described in this practice is applicable only if unit or tenant space utility data is made available to the person conducting the *BEPA*. If only a sampling of unit or tenant space utility data is made available to the person conducting the *BEPA*, such sampling can be used only if it is: *(1)* judged to be representative of unit or tenant space at the building and *(2)* sufficient to estimate *energy consumption* for all tenants at the building.

7.6 *Reliance*—A *Consultant* is not required to verify independently the information provided by others and may rely on the information provided unless he or she has *actual knowledge* that certain information is incorrect, or unless it is obvious that

certain information is incorrect based on the *Consultant's* experience or other information obtained in the *BEPA*.

8. Site Visit

8.1 *Objective*—The objective of the *site visit* is to: *(1)* interview persons at the building who are knowledgeable about building *energy consumption* and cost (see Section 9); *(2)* observe major building systems that can impact *energy consumption*; *(3)* collect available utility and other records, if not previously provided, including operation and maintenance data, from either building personnel or the utility/energy service provider servicing the property that will assist in analysis of building *energy consumption* (see Section 10); and *(4)* verify the information received, to the extent possible.

8.2 *Interviewing Knowledgeable Personnel during the Site Visit*—See Section 9.

8.2.1 *Identification of Key Site Manager before the Site Visit*—The *user* shall identify for the *Consultant* the *key site manager* or a knowledgeable representative at the property before the *site visit*.

8.2.2 *Interviewing the Key Site Manager*—The *key site manager* or a knowledgeable representative shall be interviewed during the *site visit* and accompany, if possible, the *Consultant* on the building *walk-through*.

8.3 *Observation during the Building Walk-Through*—Major building and site components that can impact *energy consumption* shall be visually observed. A sample checklist of the information that may be collected during the *walk-through* and *interviews* is included in Appendix X8.

8.3.1 *Exterior*—The periphery of the building shall be visually observed. If lighted open air parking is associated with the building, this shall be noted.

8.3.2 *Interior*—The interior of the building, accessible common areas expected to be used by *occupants* or the public (such as lobbies, hallways, utility rooms, recreation areas, and so forth), maintenance and repair areas, including boiler rooms, and a representative sample of occupant spaces, shall be visually observed. It is not necessary to look under floors, above ceilings, inside equipment, or behind walls. The number of electric meters (and what they monitor) shall be visually observed.

8.4 *Obtaining Information on Building Characteristics*—*Observations* and *interviews* shall be used to provide a comprehensive building description in the *report* (refer to subsection 10.2 and Appendix X5). ASHRAE Procedures for Commercial Building Energy Audits may be used as a template.

8.5 *Collecting Available Building Energy Consumption and Cost Records at the Site*—See Section 10.

8.5.1 Before the *site visit*, the *Consultant* shall contact the *user* or, if authorized by the *user*, the building *owner*, *operator*, or *key site manager*, or other third parties such as the local utility or utility bill payment service provider, and request specific records (see subsections 10.2 and 10.3) either to be forwarded before the *site visit* or be available for review during the *site visit*.

8.5.2 During the *site visit*, *Consultant* shall collect the following information, or confirm that such information collected prior to the *site visit* is complete.

8.5.2.1 Building *energy consumption* records over the previous three years, or back to the last *major renovation* (if less than 3 years ago), with a minimum period of one year.

8.5.2.2 Building energy cost records over the previous three years, or back to the last *major renovation* (if less than 3 years ago), with a minimum period of one year.

8.5.2.3 Other pertinent building *energy consumption* records or reports such as may be available, including, but not limited to energy audit reports, operation and maintenance records, as-built drawings, energy labeling reports (refer to Appendix X2, for example, ASHRAE or ENERGY STAR labeling reports), or green building rating or certification reports (refer to Appendix X2, for example, LEED certification or Green Globes certification reports).

8.6 *Review of Helpful Documents*—Before the *site visit*, the *property owner*, *key site manager*, or the *user* shall be asked if they know whether any of the information listed in 10.2 and 10.3 exist and, if so, whether copies can and will be provided to the *Consultant* either before or at the time of the *site visit*. Even partial information provided may be useful. If the information is provided before or at the time of the *site visit*, the *Consultant* conducting the *site visit* shall review the available documents before or at the beginning of the *site visit*.

8.7 *Frequency*—It is not expected that more than one visit to the *property* shall be made in connection with a *BEPA*. This visit may be conducted in conjunction with the *walk-through* survey conducted for the E2018 *PCA* or the *site visit* associated with the E1527 *ESA*, with the duration on-site depending, among other things, on property size and complexity.

9. Interview with Owner, Operator or Key Site Manager

9.1 *Objective*—The objective of the *interview* is to *(1)* interview persons at the building who are knowledgeable about building *energy consumption* and cost; *(2)* collect available utility and other records, if not previously provided, including operation and maintenance data, that will assist in analysis of *building energy performance* (see Section 10); and *(3)* verify the information received, to the extent possible.

9.2 *Content*—The *interview* with the building *owner*, *operator*, or *key site manager* consists of questions designed to: *(1)* collect *BEPA* supporting information if not previously provided; *(2)* fill in *data gaps* that exist in the information received; *(3)* confirm building operating characteristics; and *(4)* verify major building *energy consumption* systems.

9.3 *Medium*—Questions to be asked pursuant to this section may be asked in person (during the *site visit*), by telephone, or in writing, at the discretion of the *Consultant*.

9.4 *Who Should be Interviewed:*

9.4.1 *Key Site Manager*—Before the *site visit*, the *user* should be asked to identify a person with knowledge of the building and its physical and operational characteristics. Often the *key site manager* will be the property manager, the chief physical plant supervisor, or head maintenance person. If a *key site manager* is identified, the *Consultant* conducting the *site*

visit shall arrange a mutually convenient appointment for the *site visit* when the *key site manager* agrees to be there. It is within the discretion of the *Consultant* to decide which questions to ask before, during, or after the *site visit* or in some combination thereof. The questions asked shall be directed at obtaining the information in 10.2 and 10.3 (see the sample checklist in Appendix X8).

9.4.2 *Quality of the Answers*—The person(s) interviewed should be asked to be as specific as reasonably feasible in answering questions. The person(s) interviewed should be asked to answer in *good faith* and to the extent of their knowledge.

9.4.3 *Incomplete Answers*—While the *Consultant* conducting the interview(s) has an obligation to ask questions, in many instances the persons to whom the questions are addressed will only be able to answer specific questions to the best of their knowledge. If the person being interviewed does not provide answers or provides only partial answers to specific questions, this section of the *BEPA* shall not be deemed incomplete, provided that sufficient information has been collected to allow the *Consultant* to complete the *BEPA*.

10. Records Collection

10.1 *Objective*—The purpose of *records collection* is to obtain and compile utility and other such records that will help identify: *(1)* historical building *energy consumption* over the previous three years, with a minimum of one year, or back to the last *major renovation* (if completed less than three years ago); *(2)* the range of building *energy consumption* and cost under average, *upper limit* and *lower limit scenarios* as defined in this practice; *(3) pro forma building energy consumption* and *pro forma building energy cost*; and *(4) appropriate reporting* of building *energy consumption* and cost information to the *user* or other *user*-designated parties.

10.1.1 *Accuracy and Completeness*—Accuracy and completeness of record information varies among information sources, including governmental and utility sources. Record information may be inaccurate or incomplete. The *user* or *Consultant* is not obligated to identify mistakes or insufficiencies in the information provided. However, the *Consultant* reviewing records shall make a reasonable effort to compensate for mistakes or insufficiencies in the information reviewed that are *obvious* in light of the *Consultant's* experience or other information of which the *Consultant* has *actual knowledge* or both.

10.1.2 *Reasonably Ascertainable Data*—Availability of record information varies among information sources, including governmental and utility sources. The *user* or *Consultant* is not obligated to identify, obtain, or review every possible record that might exist with respect to a building. Instead, the *user* or *Consultant* is required to review only record information that is *reasonably ascertainable*. Record information that is *reasonably ascertainable* means: *(1)* information that is *readily available*; *(2)* information that is *practically reviewable*; and *(3)* information that is obtainable from its source within reasonable time and cost constraints.

10.1.2.1 *Readily Available*—Information or records that are easily and promptly provided by a source to the individual making a request through an appropriate inquiry and without the need to research archive files.

(1) Discussion—In those states and municipalities with building energy performance benchmarking ordinances and regulations (refer to 4.1.1), where reported *building energy performance data* is publicly available, the *user* or *Consultant* should access this information in the conduct of the *BEPA* assessment. Depending on local requirements, building owners may be required to retain records of information reported under *building energy performance* disclosure regulations.

10.1.2.2 *Practically Reviewable*—Information that is *practically reviewable* means that the information is provided by the source in a manner and in a form that, upon examination, yields information relevant to the building without the need for extraordinary analysis of irrelevant data.

10.1.2.3 *Reasonable Time and Cost*—Information that is obtainable within reasonable time and cost constraints means that the information will be provided by the source within 20 calendar days of receiving a written, telephone, or in-person request at no more than a nominal cost intended to cover the source's cost of retrieving and duplicating the information. Information that can only be reviewed by a visit to the source is *reasonably ascertainable* if the visit is permitted by the source within 20 days of request.

10.1.3 *Coordination*—If records are not *reasonably ascertainable*, the *Consultant* shall attempt to obtain the requested information from other sources as determined by the *user* and *Consultant*. If the information is not available to conduct the *BEPA* described in this practice, the *Consultant* shall notify the *user* and determine what further action, if any, is appropriate.

10.2 *Building Characteristics Data*—The *Consultant* shall collect from the *user* or building *owner*, *operator*, or *key site manager* or other knowledgeable party the following information:

10.2.1 Building name and address;

10.2.2 Building type and category (see sample checklist in Appendix X7);

10.2.3 Building description, including, at the minimum, building construction, whether or not *renewable/alternative energy* sources (such as solar or wind) are used at the building, the number of floors, number of electric meters and areas covered, percent of floor area that is air conditioned, percent of floor area that is heated, approximate number of *occupants* in the building, weekly operating hours and description of tenants;

10.2.4 Description of parking area including, at the minimum, gross square footage, number of parking spaces, whether the parking is indoor (enclosed) or outdoor (unenclosed with a roof) or open (no roof or structure), whether or not the parking area is attached to the building, whether or not the parking area is individually metered for electricity use (for example, for lighting or ventilation in the case of in-building parking, or both);

10.2.4.1 If electricity use associated with a parking area for a building is not separately metered and the building's *ECI* will be compared to other similar buildings (not a part of the *BEPA* scope of work in this practice), the *Consultant* should estimate

the electricity use of the parking area and exclude it from the building's *energy consumption*.

10.2.5 Building *gross floor area* in square feet (as distinguished from the building rentable or leasable square feet);

10.2.6 Year of construction, and applicable energy code at the time of construction, if *readily available*;

10.2.7 Completion date of the last *major renovation*, and applicable energy code at the time of renovation if *readily available*;

10.2.8 Monthly occupancy (or *vacancy*) rate going back three years (or to the last *major renovation* (if less than 3 years ago), with one year minimum);

10.2.9 Monthly operating hours going back three years (or to the last *major renovation* (if less than 3 years ago), with one year minimum);

10.2.10 Previous energy audit reports, if *readily available*;

10.2.11 Building energy labeling, rating and certification reports or sustainability certification reports, if *readily available*.

10.3 *Building Historical Energy Consumption*—The *Consultant* shall collect from the *user*, building *owner*, *operator*, or *key site manager* or other knowledgeable party (such as the local utility or energy provider) the following information over a three- year time period, or to the last *major renovation* (if completed less than 3 years ago), with a minimum period of one year:

10.3.1 *Electricity Use:*

10.3.1.1 Utility name,

10.3.1.2 Electricity use (kWh),

10.3.1.3 Peak electricity demand (maximum kW demand for each month of a twelve-month period), and

10.3.1.4 On-site electricity generation (kWh) and method, for example, from on-site solar panels or combined heat and power system.

10.3.2 *On-site Fuel for Heating or Cooling:*

10.3.2.1 Fuel type(s), including renewable energy;

10.3.2.2 Utility or provider name(s);

10.3.2.3 Fuel usage; and

10.3.2.4 Heating provided by a solar thermal system or waste heat produced by a combined heat and power system.

10.3.3 *District Steam, Hot Water, or Chilled Water:*

10.3.3.1 Type,

10.3.3.2 District system provider, and

10.3.3.3 Usage.

10.3.4 *Cost Data:*

10.3.4.1 Purchased total annual electricity cost,

10.3.4.2 Purchased total electricity cost per kWh,

10.3.4.3 On-site total annual fuel usage cost,

10.3.4.4 On-site total annual cost per unit of fuel used,

10.3.4.5 Total annual cost of district steam, hot water or chilled water, and

10.3.4.6 Total annual cost per unit of district steam, hot water, or chilled water.

10.4 *Weather Data*—Weather data representative of the area where the building is located (for example, at the nearest weather station) shall be collected, including:

10.4.1 Monthly *HDD* back three years or to the last *major renovation* of the building (if completed less than 3 years ago), with a minimum period of twelve consecutive months.

10.4.2 Monthly *CDD* back three years or to the last *major renovation* of the building (if completed less than 3 years ago), with a minimum period of twelve consecutive months.

10.5 *Documentation of Sources Checked*—The *report* shall document each source that was used, for example, utility bills, installed meters, and so forth. Supporting documentation shall be included in the *report* or adequately referenced to facilitate reconstruction of the assessment by a *Consultant* other than the *Consultant* who conducted it.

11. Records Review and Analysis

11.1 *Objective*—The purpose of records review and analysis is to review and analyze records collected in Section 10 that will help identify: *(1)* historical building *energy consumption* over the previous three years, with a minimum of one year, or back to the last *major renovation* (if completed less than three years ago); *(2)* the range of building *energy consumption* and cost under average, *upper limit* and *lower limit scenario*s as defined in this practice; *(3) pro forma building energy consumption* and *pro forma building energy cost*; and *(4) appropriate reporting* of building *energy consumption* and cost information to the *user* or other *user*-designated parties.

11.2 *Consistent Reporting of Energy Consumption Data*—Building *energy consumption* data shall be analyzed on a monthly average basis normalized for the calendar month. If data is reported for a non-calendar month period (such as for two partial months), the data shall be converted to a calendar month basis. This may be accomplished by determining average daily usage during each partial month covered, and summing the daily average usage over the number of days in the calendar month. If raw fuel such as fuel oil, propane or coal, is delivered to a facility, *energy consumption* in a given time period may be estimated by the *Consultant* based upon the actual use between successive deliveries. Estimated monthly use for raw fuel may then be determined by pro-rating actual use between successive deliveries by an appropriate metric such as the *HDD* if the fuel is used for space heating. If the fuel is used for non-space heating, for example, domestic hot water, the extent of such may be determined from fuel usage when space heating requirements do not exist, for example, summer months.

11.3 *Building Energy Consumption Metrics*—Building *energy consumption* metrics shall be determined on an annual basis. When the metric is normalized by the *gross floor area*, this assumes that the *gross floor area* did not vary over the time period associated with the analysis. If a parking lot is associated with the building on which the *BEPA* is conducted, the *energy consumption* associated with this parking area (such as, for example, the *energy consumption* associated with lighting in the parking lot) should not be included in the building *energy consumption* and ECI analysis but should be identifed separately.

11.3.1 Determine electricity consumption in kWh/yr, kBtu/yr, kWh/SF-yr, and kBtu/SF-yr, with a brief description of the

major electrical use end uses (for example, air conditioning, lighting, data center, and so forth). The conversion factor for electricity to Btu is 3,412.14 Btu/kWh or 3.41214 kBtu/kWh.

11.3.2 Determine on-site fuel usage in kBtu/yr and kBtu/SF-yr, with a description of on-site fuel use. *Heating values* of fuels reported on utility bills are typically adjusted for delivered heat content, elevation, and temperature, so additional corrections are not needed. If fuel content values are not available from the local utility, they may be estimated using the higher *heating value*s in Table 1. If the building is located at greater than 2000 ft (610 m) above mean sea level, gas *heating value*s should be adjusted for elevation as follows:

$$E_a = (E_u)(F_a)$$
$$F_a = (P_{atm} + P_{meter})/14.7$$

where:

E_a = adjusted gas *heating value*,
E_u = unadjusted gas *heating value*,
F_a = multiplication factor for elevation,
P_{atm} = $(14.7)(1 - 6.8754 \times 10^{-6}A)^{5.2559}$ psig,
P_{meter} = meter pressure in psig (if not known, assume 0.22 psig), and
A = elevation above mean sea level, feet.

11.3.2.1 For example, buildings at 2,000- to 4,000-ft (610- to 1,219-m) elevation will have an adjusted gas *heating value* approximately 92 % of the value in Table 1, and buildings at 4,000- to 5,000-ft (1,219- to 1,524-m) elevation will have an adjusted gas *heating value* approximately 86 % of the value in Table 1.

11.3.3 Delivered energy from district systems (steam, hot water, and/or chilled water) in kBtu/yr and kBtu/SF-yr, with a description of delivered *district energy*.

11.3.4 Energy generated on-site by *renewable/alternative energy* systems (such as solar voltaic, wind, combined heat and power systems) in kWh/yr, kBtu/yr, kWh/SF-yr, and kBtu/SF-yr, with a description of the alternative energy system and its operation.

11.3.5 *Total Energy Consumption* (as determined in 11.3.1 through 11.3.4) in kBtu/yr and kBtu/SF-yr. If an alternative energy system is used to satisfy a portion of total energy demand, *total energy consumption* shall be identified with and without the contribution of said *renewable/alternative energy* system.

TABLE 1 Higher Heating Values (HHV) of Common Fuels[A]

Fuel	HHV
Fuel Oil	
#1	135,000 Btu/U.S. gallon
#2	139,000 Btu/U.S. gallon
#4	146,000 Btu/U.S. gallon
#5 Light	148,000 Btu/U.S. gallon
#5 Heavy	150,000 Btu/U.S. gallon
#6	154,000 Btu/U.S. gallon
Natural Gas	1,030 Btu/Std. Cu. Ft. (14.7 psia, 60°F) (1 therm = 100,000 Btu)
Propane	91,600 Btu/U.S. gallon
Coal	
Anthracite	12,700 Btu/lb
Semianthracite	13,600 Btu/lb
Low-volatile Bituminous	14,350 Btu/lb
Medium-volatile Bituminous	14,000 Btu/lb
High-Volatile Bituminous	11,000 to 13,800 Btu/lb
Subbituminous	8,500 to 9,000 Btu/lb

[A] ANSI/ASHRAE Standard 105-2007

11.4 *Building Energy Consumption and Cost Range*—Historical building *energy consumption* and costs may not be indicative of current *energy consumption* and costs based upon the manner in which the building is operated at the time of the *real estate transaction* and the prevailing utility/energy rates at that time. Moreover, external factors such as unusual weather conditions may have also impacted historical *energy consumption*. Energy cost information is a relatively significant building expense line item and impacts a building's net operating income (NOI). The building's *total energy consumption* shall be estimated for reasonable lower limit, reasonable upper limit, and average case conditions using the building *energy consumption equation* calculation procedure (see subsection 11.4.1) or any other manner in which the *Consultant* conducting the *BEPA* decides may be appropriate (for example, by analysis and extrapolation of the historical data or the trailing twelve-months data).

11.4.1 *Building Energy Consumption Equation*—The building *energy consumption equation* relates the dependent variable, total building *energy consumption*, including use of electricity and on-site fuel/district energy, to independent variables whose variability is known to impact materially building *energy consumption*. Independent variables may, for example, include weather conditions (*HDD* and *CDD*), operating hours for the building, occupancy (or vacancy) rate, and number of *occupants*. Independent variables may also include any other variable(s) judged to have a significant influence on building *energy consumption* and deemed by the *BEPA Consultant* to be available, appropriate, and relevant for the analysis. The *energy consumption equation* for the building may be determined for electricity and fuel separately, or for the total (combined) *energy consumption*.

11.4.1.1 *Calculation Procedure*—The building *energy consumption equation* can be determined using a weighted ordinary least squares regression. This basic form of multiple linear regression allows for analysis of a dependent variable (that is, building *energy consumption intensity* in kBtu/SF-month), as a function of various independent variables or characteristics that can vary monthly (for example, heating degree days, cooling degree days, building *occupancy*, building operating hours, and so forth). The linear regression will yield an equation of the form:

$$\textit{Monthly Building Energy Use}\,(\text{kBtu/SF}) = C_0 + C_1 * \text{Characteristic}_1 + C_2 * \text{Characteristic}_2 + \ldots C_n * \text{Characteristic}_n$$

where C_0 represents a constant with the other C values representing equation coefficients. Characteristic_1 may be the actual monthly average *HDD*, for example, and Characteristic_2 the actual monthly average *CDD*, Characteristic_3 the actual monthly average *vacancy* level (%), and so forth. Assuming that three 3 years of monthly data are available and collected, there will be 36 sets of data points for the regression analysis. The *consultant* also has the option of conducting a more advanced regression analysis (such as, for example, a polynomial regression) if the ordinary least squares regression is