



**BSR/ASHRAE/ACCA Addendum d
to ANSI/ASHRAE/ACCA Standard 211-2018 (RA 2023)**

Publication Review Draft

Proposed Addendum d to Standard 211-2018 (RA 2023), Standard for Commercial Building Energy Audits

**First Advisory Public Review (June 2026)
(Draft Shows Proposed Changes to Current Standard)**

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI. Until this time, the current edition of the standard (as modified by any published addenda on the ASHRAE website) remains in effect. The current edition of any standard may be purchased from the ASHRAE Online Store at www.ashrae.org/bookstore or by calling 404-636-8400 or 1-800-727-4723 (for orders in the U.S. or Canada).

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(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

This addendum updates Section 5, Procedures, to include procedures for Level 1 and Level 2 Decarbonization Assessment. It clarifies the relationship between an energy audit and a decarbonization assessment. It also defines a ‘Qualified Decarbonization Assessor’ (QDA) and lists the roles and responsibilities of a QDA.

The SSPC would like comments and inputs on several section and specific areas for input have been identified throughout the addendum.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~striketrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes. Only these changes are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed substantive changes.

Addendum d

1 [...]

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3 DEFINITIONS

qualified decarbonization assessor (QDA): a decarbonization professional who assesses building systems and site conditions; analyzes and evaluates equipment and operational GHG emissions; and recommends strategies to reduce or eliminate those emissions.

The assessor must be one of the following:

1. A person who meets all the requirements of a QEA, and has attained one of the following certifications or certificates:
 - a. ASHRAE Certified Decarbonization Professional
 - b. Association of Energy Engineers Carbon Auditing Professional
 - c. Association of Energy Engineers Certified Energy Manager, or Certified Energy Auditor, with a Decarbonization Assessment Certificate
 - d. Other program approved by the AHJ
2. A person approved as qualified by the AHJ

Informative note: The certification/certificate should cover the following topics at a minimum:

- Developing a GHG emissions inventory for Scope 1 and Scope 2 emissions
- Converting energy usage and energy savings to GHG equivalents
- Identifying ERMs, including through energy efficiency, reduction or elimination of on-site combustion of fossil fuels, reduction of refrigerant emissions, and renewable energy or other low-carbon or carbon-free energy sources.

4 COMPLIANCE REQUIREMENTS

5 PROCEDURES

5.1 Scope of Systems

5.2 General Procedures

5.2.1 Introduction

5.2.1.1 **Energy Audit**

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 2 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.

5.2.1.2 **Decarbonization Assessment:**

This standard defines three levels of *decarbonization assessments*: Levels 1 and 2. Each successive level builds on the preceding levels, such that a Level 2 *decarbonization assessment* includes all items that had already been required through a Level 1 *decarbonization assessment*. A preliminary emissions analysis is included in the Level 1 decarbonization assessment.

5.2.2 Role of the **Qualified Assessor**

5.2.2.1 **Role of the Qualified Energy Auditor**

The following activities must be completed by the qualified energy auditor ~~to achieve compliance~~:

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

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

5.2.2.2 **Role of the Qualified Decarbonization Assessor**

The following activities must be completed by the *qualified decarbonization assessor*:

- Conduct a site visit
- Identify and qualify EEMs and ERMs
- Conduct quality assurance
- Present results to building owner
- Sign the compliance form.

The *qualified decarbonization assessor* shall conduct or supervise the completion of all other required tasks as described in this standard.

5.2.3 Preliminary **Energy Use Analysis (Benchmarking)**

The requirements for a preliminary analysis for an *energy audit* and *decarbonization assessment* are specified in Section 5.2.3.1 and Section 5.2.3.2 respectively.

The *decarbonization assessment* shall include all the requirements under Section 5.2.3.1, *energy audit* scope, as well as the requirements specified in Section 5.2.3.1

5.2.3.1 **Energy Audit Scope**

Energy audit scope includes the following requirements for a Preliminary Analysis

5.2.3.1.1 **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 105, *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 data estimation was performed and describe the estimation methodology/approach used.

EUI as used here is defined as the total annual site energy or building energy consumption divided by the gross floor area. As used here, site energy includes all energy used in the building as measured at the site boundary (see Figure 1), i.e., the net (imported minus exported) energy crossing the site boundary. This excludes energy used in the building that is produced by onsite solar, wind, or other renewable energy sources. ASHRAE Standard 405 228 also uses the term building energy to describe the net energy used in the building as measured at the building boundary (see Figure 1); thus, building energy includes onsite renewable energy used in the building but excludes surplus renewable energy that is exported from the building. Energy to charge, discharge, or refuel vehicles that leave the site boundary shall not be included as part of site energy.

Because the EUI documented in Section 5.3.1 may not have the metering required to measure the onsite renewable contribution to building use, either site or building energy use (or both) are acceptable means of reporting the EUI.

If renewable energy resources produce power onsite, EUI_{site} will be lower than EUI_{bld} . The addition of renewable generation lowers EUI_{site} , just as energy efficiency measures (EEMs) do. However, EUI_{bld} is not lowered by the addition of onsite renewable generation.

5.2.3.1.2 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.”~~ Summary information about benchmarking energy use, based on 2003 CBECS data, is presented in the 2015 ASHRAE Handbook—HVAC Applications (Chapter 36).; however, more recent analyses should reference the 2018 CBECS data. More recent 2018+2 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 2020+9 RECS statistics or from Energy Performance Measurement Institute (EPMI).

5.2.3.1.3 Calculate the Energy Cost Index.

Calculate total annual building energy cost, including all taxes, and divide by gross floor area to obtain the Energy Cost Index (ECI). The method used to determine total annual building energy cost and any relevant normalizing parameters shall be described in a transparent manner and included with any PEA reporting requirements for ECI.

5.2.3.1.4 Compare EUI to a Peer Sample.

The EUI for the building shall be benchmarked using one or more of the following methods. Note that meeting performance targets or compliance with certification levels is not required under this standard.

- a. Compare to peer buildings, such as ASHRAE/IES Standard 100²; DOE Commercial Building Energy Consumption Survey (CBECS) summary data documented in *ASHRAE Handbook—HVAC Applications*³, Chapter 36, Tables 2 through 4; CIBSE benchmarks; or subsequent versions of these data⁴. For multifamily buildings, 2009 RECS statistics⁵ and data from EPMI⁶ are appropriate.
- b. Calculate the ENERGY STAR score. Benchmark energy use, energy cost, and emissions using the U.S. Environmental Protection Agency's (EPA) ENERGY STAR Portfolio Manager benchmarking tool.

Informative Note: ENERGY STAR Portfolio Manager is a free, online tool that compares measured building energy performance to other similar buildings. The calculator accounts for building characteristics and uses site-specific historical weather data while allowing users to define the build-

ing-specific operation characteristics for a variety of building types or specify unique utilization features. Based on these user inputs, the tool provides an ENERGY STAR score of 1 to 100, among other energy performance metrics.

- Use the ASHRAE Building Energy Quotient (Building EQ) in Operation Rating. Building EQ is a voluntary labeling program that compares a building's annual EUI to the median EUI by building type. Report the resulting Building EQ score.
- Benchmark using the DOE Building Performance Database (BPD), produced by Lawrence Berkeley National Laboratory. Report the selection criteria used to define the peer group for comparison, including the total number of buildings in the resulting sample.
- Use another benchmarking system or peer sample that can be demonstrated to provide a reasonable sample for comparison. Report the selection criteria used to define the peer group for comparison, including the total number of buildings in the resulting sample.
- Results of comparison should be reported using the forms provided in Normative Appendix C.

5.2.3.1.5 Hazardous Materials and Unsafe Conditions.

An inventory of hazardous materials or unsafe conditions is not required. However, if the qualified energy auditor, through the course of the energy audit or otherwise, becomes aware of the possible presence of hazardous materials or unsafe conditions at the site, either through observation or as reported by others, the possible presence of the hazardous materials and any unsafe condition shall be included in the report and reported immediately to the building owner's representative.

Table 1 Building Size (Total Number of Dwelling or Commercial Units)

Number of Units	Units Minimum, % of units
<100	10%
100 to 300	8%
>300	6%

5.2.3.2 Decarbonization Assessment Scope

The decarbonization assessment shall include all the requirements under Section 5.2.3.1, *energy audit* scope, as well as the following requirements.

5.2.3.2.1 Calculate the GHG Emissions Intensity

Convert site energy use (E_{site}), as defined in Figure 1, to Scope 1 and Scope 2 emissions using a transparent approach. Calculate the annual GHG intensity metric ($lbCO_2e/ft^2 \cdot yr$ or $kgCO_2e/ft^2 \cdot yr$ or $kgCO_2e/m^2 \cdot yr$) for building-related Scope 1, Scope 2 and total emissions. Refrigerant losses shall be added to Scope 1 emissions, converting to CO_2e based on global warming potential (GWP). The QDA shall specify the data source and time period (20-year vs 100-year) of the refrigerant GWPs. The QDA shall state whether they're using marginal or annual average emission factors in their emission calculations, along with the source of the emission factors. The QDA shall identify if tenant energy use, or if specific spaces are included or excluded from Scope 1 and Scope 2 emissions.

Informative Notes:

- Some jurisdictions' building performance standards do not address tenant spaces, and emission accounting standards allow upstream and downstream leased assets to be reported as either Scope 2 or Scope 3, depending on the organization's GHG reporting boundary.
- In the case that an AHJ allows for projecting electric grid emissions (and district energy) factors into the future, and the impact on annual GHG intensity metric going forward, cite sources and assumptions for emissions conversions projections.
- There are several published approaches for converting energy use to GHG emissions. These include the following:
 - ASHRAE Standard 90.1-2025, Appendix I
 - ASHRAE Standard 189.1-2023
 - ASHRAE Standard 228-2023
 - ASHRAE Standard 100-2023

- 2021 ASHRAE Handbook—Fundamentals Chapter 29, Tables 3B and
- Cambium
- EPA’s reference for GWP (GreenChill)
- EPA’s eGRID emissions rates
- EPA’s Portfolio Manager emissions factors
- Emission factors as published by local utility and/or district energy systems

5.2.3.2.2 Benchmarking

Benchmark the building’s GHG emissions intensity relative to similar (peer) buildings using emission 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:

Some of the available GHG emissions benchmarking sources include:

- ASHRAE Standard 100
- ENERGY STAR NextGen
- ENERGY STAR Portfolio Manager Data Explorer
- Global Real Estate Sustainability Benchmark (GRESB)
- Performance targets as defined by a local building performance standard (if applicable)

5.3 Level 1 Procedures

The Level 1 *energy audit* and *decarbonization assessment* procedures are defined in Sections 5.3.1 and Sections 5.3.2 respectively. The *decarbonization assessment* shall include all the requirements under Section 5.3.1, *energy audit* scope, as well as the requirements specified in Section 5.3.2.

Informative Note: Informative Figure 1 provides an overview of the key distinctions between the energy audit scope and decarbonization assessment scope for each Section.

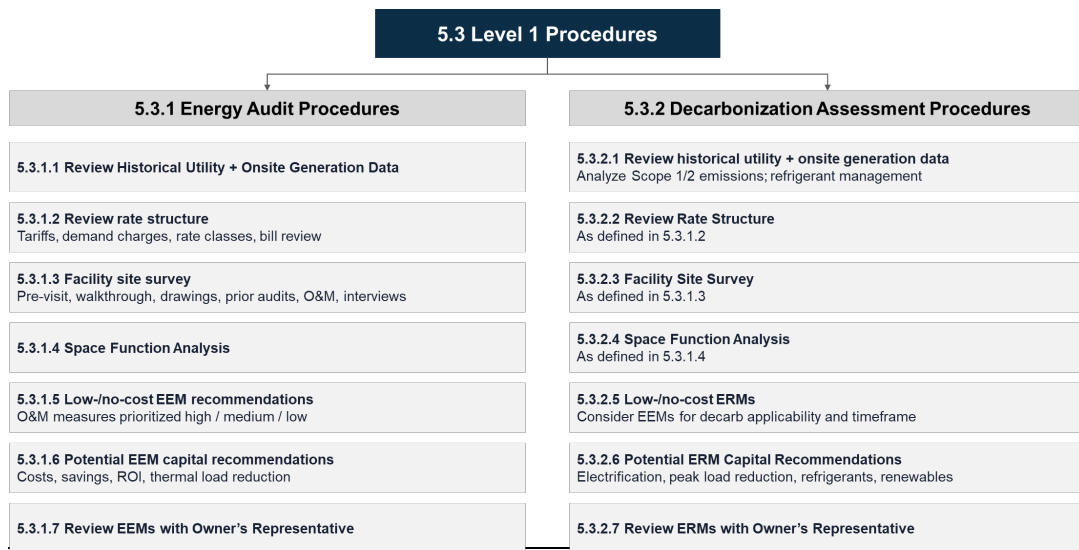


Figure 1: Overview of Level 1 Energy Audit Procedures and Decarbonization Assessment Procedures

[Note for Reviewers: This graphic will be updated to include a description of the key difference between the procedures for energy audit scope and decarbonization assessment scope for each section.]

5.3.1 Energy Audit Procedures

5.3.1.1 Review Historical Utility and Onsite Generation Data.

Prior to the site visit, review monthly and annual utility data, as collected in the Preliminary Analysis PEA of Section 5.2.3. The data shall include a minimum of 12 consecutive months (up to three consecutive years shall be used as available), aggregated for the whole building in accordance with ASHRAE Standard 105, Section 5.3. Whole-building aggregated data through ENERGY STAR Portfolio Manager may be used if available.

5.3.1.1.1 Historical Billing Data.

The following data shall be reviewed:

- a. Years for which data are collected, indicating calendar year or beginning and ending months.
- b. Utility or other energy suppliers (electricity, natural gas, fuel oil, steam, chilled or hot water).
- c. Monthly and annual electricity use (kWh) and cost (\$) for each year (total cost including taxes and fees).
- d. Actual or billed monthly peak electric demand (kW).
- e. Monthly and annual site fuel (or other energy source) use in therms, gal, lbs, MJ, or kBtu, as appropriate, and cost (\$). If fuel is delivered as a liquid or solid, estimate and report the annual amount used from actual delivered quantities or inventory change for each year.
- f. Peak or billed monthly fuel, steam, hot-water, or chilled-water demand (in appropriate units), if reported, for each year.
- g. Onsite generation data (kWh).
- h. Annual EUI (kBtu/ft²·yr or MJ/m²·yr) and ECI (\$/ft²·yr or \$/m²·yr) as determined in Section 5.2.3.

Review unexpected or irregular patterns in monthly energy use that may indicate abnormal building operation and identify possible causes.

5.3.1.1.2 Sampling Procedure.

For buildings with multiple tenants, the following sampling procedure shall be applied. If the scope of the energy audit, as determined by the building owner or the AHJ, only includes common spaces in the building, no sampling is required. If the scope includes the entire building, the following sampling procedure shall be used.

When the tenant spaces in a multitenant (commercial or residential rental tenant, cooperative tenant, or condo unit owner) building are individually metered rather than master metered, the following random sampling procedure shall be applied. The owner shall obtain representative tenant/occupant unit meter data for each energy type for a minimum of spaces representing each space type in the building (except those comprising <5% of the total building floor area, which may be omitted). Spaces are considered of the same type if they have similar size and use, for example:

- i. Retail: grocery store, restaurants, dry goods store, big box
- j. Offices: small, medium, large units
- k. Apartments: studios, one bedroom, two bedrooms, three or more bedrooms

The required minimum number of units to be sampled is determined in Table 1.

When an owner obtains representative billing or meter data for a given energy source, as described above, the auditor may extrapolate such information for the building as the actual energy data for the whole building.

Exception to 5.3.1.1.1: If sufficient tenants are unable or unwilling to provide metered energy use data, the requirements of Section 5.3.1 may be waived by the AHJ.

5.3.1.2 Review Rate Structure

5.3.1.2.1 For each metered energy source, identify utility rate/tariff schedule elements, such as the following:

- l. Time-of-use structure
- m. Block structure
- n. Number of accounts for each fuel type
- o. Basic service charge
- p. Demand charges (ratchet or nonratchet, contract demand minimum)
- q. Power factor charges
- r. Consumption charges
- s. Renewable portfolio standard charges
- t. Taxes
- u. Credits

For each delivered energy source, identify delivered fuel rate/tariff schedule, including taxes.

5.3.1.2.2 Review monthly utility bills for opportunities to lower costs.

Consider taking advantage of different utility rate classes, accounting for electric demand patterns and charges. Consider potential advantages and disadvantages of optional rates such as time-of-use and real-time pricing. Consider load-shifting opportunities to reduce demand charges. Consider potential benefits of account or meter consolidation when many accounts or meters are in use.

5.3.1.3 Facility Site Survey

5.3.1.3.1 Prior to Site Visit.

Prior to visiting the facility, communicate with the building owner or operator to determine basic facility characteristics and to request as-built drawings, historical utility bills (see Section 5.3.1), and equipment schedules. Record these characteristics, including, at a minimum, the following:

- a. Project and client names
- b. Key contacts
- c. Site address
- d. Building type and function
- e. Year constructed and dates of renovations/additions
- f. Number of floors
- g. Number of occupants and schedule of building occupancy. (For multifamily buildings or other buildings with residential occupancies, include number of dwelling units and percent occupied.)
- h. Utility rates, suppliers, and meter (and submeter) locations, data availability (hard copy or electronic)
- i. Historical preservation status

Informative Note: Where appropriate, include demographic information, such as need for multilingual skills, sampling plan, and space access procedures if available.

5.3.1.3.2 Site Visit.

Accompanied by the building operator or maintenance staff member, a qualified energy auditor shall conduct a walk-through survey of the facility to become familiar with its construction, equipment, operation, and maintenance. Remote Assessments shall not be used as a substitute for the site visit.

5.3.1.3.3 Review Drawings and Schedules

Review as-built drawings and equipment schedules, if available, to identify opportunities for efficiency within the scope of systems identified in Section 5.1.1.

5.3.1.3.4 Review previous audit reports, as available.

5.3.1.3.5 Operations and Maintenance (O&M) Problems and Needs.

As identified, report operating problems, malfunctioning equipment, maintenance costs, and maintenance needs, including revisions to O&M procedures pertaining to major energy using systems.

If, during this investigation, health or safety issues are observed or are identified by site staff, those issues shall be reported by the qualified energy auditor. Determine whether any maintenance issues or practices affect energy efficiency.

Review potential sources for funding to determine what funds are available for O&M expenditures and for capital expenditures.

5.3.1.3.6 Major Energy Using Systems

Identify major energy using systems, processes, and equipment, including equipment type, fuel source and year of installation. Gather control strategies and equipment information of major components from nameplates, as-built drawings, or other means. Review BAS sequence of operations, control set points, and sequences.

5.3.1.3.7 Interviews.

Interview the owner or operator and occupants to identify current space use, special problems (especially relating to thermal comfort or indoor air quality), and planned improvements (such as equipment and/or controls upgrades, envelope upgrades) of the facility. Determine the history of all commissioning that has been performed on the building, changes made at the site, and whether any maintenance problems and/or practices or occupant behaviors affect energy efficiency or indoor

environmental quality.

5.3.1.4 Space Function Analysis.

Conduct a space function analysis using the appropriate form in Normative Appendix C. Allocate the gross floor area of the building by standard space function types as listed in the forms.

For each space function type, determine the following (estimate as appropriate):

- a. Gross floor area associated with that function
- b. Weekly operating or occupied hours (for commercial buildings)
- c. Weeks/year of operation (for commercial buildings)
- d. Number of occupants (normal occupancy or design occupancy if intermittent)
- e. Typical plug loads (W/ft² or W/m²), including, for commercial buildings, the number of PCs and/or laptops, and for multifamily dwelling units, the average plug loads
- f. Fraction of space heated and/or cooled
- g. Principal HVAC types serving the area
- h. Principal lighting types serving the area

Determine whether efficiency may be affected by functions that differ from the original functional intent of the building.

5.3.1.5 Identify Low-Cost and No-Cost Energy Efficiency Measure (EEM) Recommendations.

Identify low-cost and no-cost changes to the facility or to O&M procedures. Estimate the approximate level of economic return from savings that will result, and report using the appropriate forms in Normative Appendix C.

Low and no-cost measures are those that can be implemented within the O&M budget for the facility, where such budget exists. The items to be considered shall be determined by the qualified energy auditor based on field observations. The basis for inclusion of these items shall be stated in the energy audit report.

5.3.1.5.1 Opportunities to Consider.

Low- or no-cost changes shall be identified by space type and energy system. Each item shall be qualitatively prioritized as high, medium, or low, depending on the significance of the expected cost savings, impact on the facility's energy consumption, effect on the other measures and building systems, ease of implementation, or other expected benefits.

Informative Note: This process of identifying no/low-cost O&M measures may be associated with existing-building commissioning ~~retrocommissioning~~ or other similar procedures (such as existing-building commissioning, ongoing commissioning, and building retuning) as defined by ASHRAE Standard 230, Commissioning Process for Existing Buildings and Systems. Some of these measures may require education of building operators and/or occupants, as they may have potential to impact indoor environmental quality (IEQ). Some may involve implementation of maintenance routines (and logs) and management practices to improve the efficiency of operations, or maintenance of such improvements after tune-ups.

5.3.1.6 Identify Potential EEM Capital Recommendations.

Identify potential capital-expensed EEMs (items not normally within the O&M budget), including a preliminary qualitative estimate of the level (high, medium, or low) of potential costs and energy cost savings, based on the qualified energy auditor's field observations.

5.3.1.6.1 Opportunities to Consider.

Potential capital changes shall be identified based on the best judgment of the qualified energy auditor, including the following:

- a. Description of recommendation
- b. Modified system type (lighting, HVAC, process/plug loads, etc.)
- c. Impact on occupant comfort or IEQ
- d. Other nonenergy impacts
- e. Qualitative assessment (high, medium, or low) for the following:
 - i. Implementation cost
 - ii. Energy and cost savings

- iii. Typical return on investment
- iv. Priority

5.3.1.6.2 Opportunities for Building Thermal Load Reduction

The QEA shall consider measures that reduce thermal loads.

Informative note: There are often opportunities to recover heat for use in lower quality thermal needs (e.g., condenser water recovery to pre-heat domestic hot water). A building thermal load profile assessment allows the assessor to understand potential heat recovery opportunities. Identification of peak thermal loads allows the assessor to identify potential peak load reductions (e.g., envelope improvements, ventilation energy recovery) to enable heating and cooling equipment capacity reduction.

[Note for Reviewers: SSPC 211 would appreciate input on this section]

5.3.1.7 Review EEMs with Owner's Representative.

The qualified energy auditor shall provide to the owner or their appropriate representative a list of identified measures with a summary of the characteristics listed in Section 5.3.6.1. The qualified energy auditor shall obtain from the owner or owner's representative their comments about which measures are preferred for implementation or further study.

5.3.2 Decarbonization Assessment Procedures

The *decarbonization assessment* shall include all the requirements under Section 5.2.3.1, *energy audit* scope, as well as the following requirements.

Informative Note: Section titles from Section 5.3.1, *energy audit* procedures, are duplicated below in order to preserve consistency with numbering. When the *decarbonization assessment* procedures align with the *energy audit* procedures, the appropriate section within *energy audit* procedures has been referenced. When the *decarbonization assessment* procedures differ from the *energy audit* procedures, the appropriate requirements have been added to the relevant section.

5.3.2.1 Review Historical Utility and Onsite Generation Data.

Prior to the site visit, review monthly and annual utility data as defined in Section 5.3.1.1

Calculate the annual GHG emission intensity for Scope 1, Scope 2, , and total emissions, as specified in Section 5.2.3.2.1. The Scope 1 and Scope 2 emissions shall be analyzed to identify the key end uses responsible for emissions.

Informative note:

Refer to Section 5.2.3.1.1. for published methodologies for converting energy use data to GHG emissions.

5.3.2.1.1 Refrigerant Management

For the *decarbonization assessment*, the *decarbonization assessment professional* shall collect information about additional non-energy GHG emission sources, including refrigerant using equipment and refrigerant losses, and identify refrigerant management practices.

The QDA shall identify all major refrigerant-using equipment in the building, including but not limited to, air conditioners and heat pumps, chillers, data center cooling equipment, process equipment and any other relevant equipment in the facility. The QDA shall review all refrigerant purchasing logs and any other records that document refrigerant use or leakage and identify ERMs related to refrigerants.

[Note for Reviewers: SSPC 211 would appreciate input on this section]

5.3.2.2 Review Rate Structure

As defined in 5.3.1.2

5.3.2.3 Facility Site Survey

As defined in 5.3.1.3

5.3.2.4 Space Function Analysis

As defined in 5.3.1.4

5.3.2.5 Identify Low-Cost and No-Cost Emission Reduction Measures (ERMs)

Low and no-cost emission reduction measures are those that can be implemented within the O&M budget for the facility, where such budget exists. Low and no-cost EEMs identified through *energy audit* procedures shall be considered by the QDA for applicability for the *decarbonization assessment* procedures. The items to be considered shall be determined by the *qualified decarbonization assessor* based on field observations. The basis for inclusion of these items shall be stated in the report. The qualified professional shall identify low-cost and no-cost changes to the facility or to O&M procedures. Estimate the approximate level of economic return from savings that will result, and report using the appropriate forms in Normative Appendix C.

Informative Note: For EEMs identified through the energy

5.3.2.5.1 Opportunities to Consider.

Low-or no-cost changes shall be identified by space type and energy system.

Each item shall be qualitatively prioritized as high, medium, or low, depending on the significance of the CO₂e emissions reduction, impact on the facility's emissions, effect on the other measures and building systems, ease of implementation, or other expected benefits.

A recommended timeframe for implementation shall be identified for low or no-cost measures. Measures that serve as potential enabling steps for longer term measures for eventual deep decarbonization plan shall also be identified.

Informative Note: These can include short-term operations and maintenance, next-year capital planning, longer term building life cycle, etc.).

5.3.2.6 Identify Potential Emission Reduction Measure Capital Recommendations.

EEMs identified through Energy Audit procedures shall be considered for applicability for the *decarbonization assessment* procedures. Beyond low- or no-cost capital measures identified in the *energy audit*, add further emissions reduction measures (ERMs) such as electrification, peak thermal load reduction, fugitive refrigerant emissions, further on-site renewables, etc. For *decarbonization assessment* scope, identify potential capital-expensed emission reduction measures (ERMs) (items not normally within the O&M budget if one exists), including a preliminary qualitative estimate of the level (high, medium, or low) of potential costs and building-related Scope 1 and Scope 2 emission savings, based on the *qualified decarbonization assessment professional's* field observations.

5.3.2.6.1 Opportunities to Consider.

Potential capital changes shall be identified based on the best judgment of the qualified decarbonization assessment professional, including the following:

- a. Description of recommendation

Informative Note: The measure description should include an ERM analysis to identify whether the identified ERM is an energy efficiency and/or load reduction measure, electrification measure, addresses **fugitive emissions**, a recommendation for on-site renewables, or other emissions reduction measure categories (to be identified by the QDA).

- b. Modified system type (lighting, HVAC, process/plug loads, etc.)
- c. Impact on occupant comfort or IEQ
- d. Other non-energy impacts

Qualitative assessment (high, medium, or low) for the following (items e through h):

- e. Implementation cost
- f. Energy cost savings
- g. Typical return on investment
- h. Priority
- i. Scope 1, Scope 2, and total emission reductions
- j. Impact of penalties or taxes from local building performance standards
- k. Impact of any potential incentives for retrofits
- l. Recommended timeframe for implementation (short term, mid-term, long term)

Informative notes:

- a. Items (e)-(h) are also included in a Level 1 *energy audit*.
- b. The timeframe for implementation should consider potential enabling steps for longer term

measures for eventual deep decarbonization plan, including but not limited to, short-term operations and maintenance, next-year capital planning and longer-term building life cycle.

5.3.2.6.2 Opportunities for Thermal Load Reduction

As defined in energy audit procedures specified in 5.3.1.6.2.

5.3.2.7 Review ERM's with Owner's Representative.

For the decarbonization assessment scope, the qualified decarbonization assessment professional shall provide to the owner or their appropriate representative(s) a list of identified measures with a summary of the characteristics listed in Section 5.3.6.1. The qualified decarbonization assessment professional shall obtain from the owner or owner's representative their comments about which measures are preferred for implementation or further study.

5.4 Level 2 Procedures.

The Level 2 energy audit and decarbonization assessment procedures are defined in Sections 5.4.1 and Sections 5.4.2 respectively

- A Level 2 energy audit shall include all of the procedures contained in Level 1 energy audit procedures, specified in Section 5.3.1
- A Level 2 decarbonization assessment shall include all of the procedures contained in Level 1 decarbonization assessment and a Level 2 energy audit scope, as specified in Section 5.3.2 and 5.4.1.

Informative Notes:

- In instances where the decarbonization assessment procedure is the same as the energy audit procedures or builds upon the energy audit procedures, the relevant Section of the energy audit procedure is referenced within the requirement for decarbonization assessment.
- Informative Figure 2 provides an overview of the key distinctions between the energy audit scope and decarbonization assessment scope for each Section.

5.4 Level 2 Procedures		
Includes Level 1 procedures + Level 2 detailed requirements		
	5.4.1 Energy Audit Procedures	5.4.2 Decarbonization Assessment Procedures
Energy cost component breakdown	5.4.1.1	5.4.2.1
Review of current O&M procedures	5.4.1.2	5.4.2.2
Facility site survey	5.4.1.3	5.4.2.3
Determine key operating parameters	5.4.1.4	5.4.2.4
Building thermal load profile assessment	5.4.1.5	5.4.2.5
Conduct end-use breakdown	5.4.1.6	5.4.2.6
Initial measures list	5.4.1.7	5.4.2.7
Calculate energy savings	5.4.1.8	5.4.2.8
Estimate EEM (ERM) costs	5.4.1.9	5.4.2.9
Conduct Economic Analysis	5.4.1.10	5.4.2.10
Quality assurance review	5.4.1.11	5.4.2.11
Review EEMs (ERMs) with owner's representative	5.4.1.12	5.4.2.12

Informative Figure 2: Overview of Level 2 Energy Audit Procedures and Decarbonization Assessment Procedures

[Note for Reviewers: This graphic will be updated to include a description of the key difference between the procedures for energy audit scope and decarbonization assessment scope for each section.]

5.4.1 Energy Audit Procedures

5.4.1.1 Energy Cost Component Breakdown.

A breakdown of the annual total energy cost by component shall be developed, showing the following at a minimum:

- Electric use cost
- Electric demand cost
- Other energy use costs (as applicable)
- Other energy demand cost (as applicable)

5.4.1.2 Facility Site Survey

Guided by the initial Level 1 walkthrough survey, a review shall be conducted of the mechanical, electrical, envelope, and other systems and their operating conditions that impact energy use, based on direct observation, interviews, testing, and as-built documentation (if available). This review shall be conducted, subsequent to or concurrent with the Level 1 survey conducted in Section 5.3, by the qualified energy auditor as part of a walkthrough survey of the building. The qualified energy auditor shall be accompanied on this survey, if available, by the building owner's representative, project manager, maintenance staff, or others with knowledge of the building's systems and operating conditions. This survey shall add further detail to the documentation assembled during the Level 1 audit if one was completed.

The review shall include the systems present in the facility and listed within the scope of Section 5.1.1.

The forms in Normative Appendix C shall be used to report these characteristics. These forms shall be completed per the facility description reporting requirements of Section 6.2.1.

5.4.1.3 Review of Current O&M Procedures.

The current operations and maintenance of building systems impacting energy use or indoor environmental quality shall be reviewed and discussed with the building owner or representative and with the building O&M staff (if applicable). The review shall include, at a minimum, the current use of spaces, how space use has changed since prior design and remodels, occupancy, scheduling, comfort and ventilation requirements, preventive maintenance activities, equipment repair histories and end-of-life considerations, and recommendations by O&M staff for potential solutions to building O&M issues.

The following documentation shall be reviewed, as available, for systems impacting energy use or indoor environmental quality:

- a. General building O&M information, including, but not limited to, building plans, as-built drawings and specifications, O&M records, O&M budgets, repairs history, equipment inventory, and building automation/control system specifics
- b. Past issues associated with the performance of energy-using building systems, such as prior building and systems commissioning efforts, as related to building comfort and energy use

5.4.1.4 Determine Key Operating Parameters.

The existing operating parameters for energy-using systems shall be determined in terms of the following. Energy using systems shall include equipment that collectively makes up greater than 80% of the energy use of the building.

- a. Operations set points, or designation of manual if applicable, including, but not limited to the following:
 1. Space heating and cooling temperature set points
 2. Space humidity set points
 3. Space lighting levels
 4. Economizer control parameters
 5. Hot-water or steam supply set point controls
 6. Chilled-water supply set point controls
 7. Condenser water temperature set-point controls
 8. Supply air temperature set-point controls
 9. Service hot water (SHW)/domestic hot water (DHW) storage and delivery temperatures
 10. Fan system flow controls (such as duct static pressure setpoint control)
 11. Ventilation level controls (where present, such as CO₂ controls)
 12. Hydronic loop system flow set points
 13. Heating and cooling system enable conditions
- b. Operating schedules, including, but not limited to the following:
 1. Major equipment operating schedules
 2. Occupied or unoccupied hours in controlled zones
 3. Space temperature set point schedules
 4. Warm-up and cool-down periods
 5. Unoccupied override conditions
 6. Lighting occupancy schedules and controls
- c. Equipment efficiencies (and the method for determining the efficiencies), including, but not limited to the following:
 1. Steady-state combustion efficiency and overall/seasonal boiler efficiency
 2. Cooling equipment efficiency
 3. Heating/cooling distribution efficiency, including
 - i. motor efficiencies and
 - ii. pump and fan efficiencies
- d. Qualitative assessment of the following:
 1. Duct and/or piping leakage losses
 2. Duct and/or piping insulation losses
 3. Steam trap losses
 4. Over conditioning losses
 5. Energy recovery efficiency
 6. Transformer efficiency

5.4.1.5 Building Thermal Load Profile Assessment

The QEA shall use the information collected and modeled to identify the following:

- Building heating and cooling load profiles
- Peak thermal loads (heating, cooling, water heating and any other major thermal needs)

Informative note: There are often opportunities to recover heat for use in lower quality thermal needs (e.g., condenser water recovery to pre-heat domestic hot water). A building thermal load profile assessment allows the assessor to understand potential heat recovery opportunities. Identification of peak thermal loads allows the assessor to identify potential peak load reductions (e.g., envelope improvements, ventilation energy recovery) to enable heating and cooling equipment capacity reduction.

Informative Note: The energy sources and sinks inventory tool provides information on potential heat recovery opportunities.

<https://retrofitplaybook.org/resource/energy-sources-and-sinks-inventory-tool/>

[Note for Reviewers: SSPC 211 would appreciate input on this section]

5.4.1.6 Conduct End-Use Breakdown.

The energy use allocation shall be quantified for each end-use system and separated by energy source type in accordance with this section and reported in accordance with Section 6.2.3.

5.4.1.6.1 Building System End-Use Categories.

The energy consumption of end-use systems shall be determined in accordance with this section. Each system or unit of equipment that uses energy shall be assigned to one or more of the end-use system types listed in this section without double counting the energy use of any system or subsystem. Each system or equipment that uses energy shall be further identified with its energy sources by type. End-use system types shall be categorized as follows, as described in Section 5.4.5.2:

- a. Space heating
- b. Space cooling
- c. Air distribution (fans)
- d. Water distribution (pumps)
- e. SHW/DHW
- f. Conveyance
- g. Lighting
- h. Plug loads
- i. Process loads
- j. Refrigeration
- k. Cooking
- l. Information technology
- m. Other

Informative Notes:

- a. For the majority of buildings where on-site transportation energy use is minimal (less than 5% of whole building energy consumption), reporting of transportation energy use is optional.
- b. In cases where there is substantial transportation energy use on-site (e.g., electric vehicle charging) that constitutes 5% or more of total building energy consumption, that transportation energy use should be reported separately, using Normative Appendix C. This reporting should include both the imported energy used for transportation energy use (as used by EV chargers or other vehicle charging or refueling), and also the exported energy such as in the charged batteries of vehicles leaving the site boundary.
- c. If all transportation energy is separately metered and is only exported to vehicle energy not used on site (charged vehicles leaving the site), then that separately metered transportation energy does not need to be reported and should be excluded from the building energy use intensity calculations, as discussed in Section 5.2.3.1.2
- d. Imported Transportation Energy used to charge electric (or other) transportation vehicles should be subtracted from the total energy use for calculation of the EUI.
- e. For guidance on estimating EV charge energy consumption, see <https://www.energystar.gov/buildings/benchmark/understand-metrics/score-details/ev-charging>

5.4.1.6.2 End-Use Systems.

For the purposes of energy use assessments, in accordance with Section 5.4.5.1, and reporting of end-use breakdown, in accordance with Section 6.2.3, the following end-use categories shall apply (each to include all energy sources used to provide the end use):

- a. "Space heating" for heating conditioned areas, including reheat. Air-handling unit fans shall be categorized as air distribution.
- b. "Space cooling" shall include refrigeration associated with cooling spaces (including terminal cooling and variable-refrigerant flow systems), chilled-water condenser fans, and cooling tower fans. Air-handling unit fans shall be categorized as air distribution.
- c. "Air distribution" shall include fan operation for ventilation, supply air, return air, exhaust, hoods, powered variable air volume (VAV), and energy recovery ventilation (ERV)/heat recovery ventilation (HRV) or other HVAC equipment pertaining to air distribution.
- d. "Water distribution" shall include pumps for chilled water, condenser water, heating hot water, condensate return, or SHW/DHW circulation, and water pressurization.
- e. "SHW/DHW" shall include hot water used for hand washing, showering/bathing, dishwashing, cleaning, and laundry.
- f. "Conveyance" shall include elevators, escalators, baggage handling, moving sidewalks, forklifts, conveyors, and similar. Note: this does not include transportation vehicle energy
- g. "Lighting" shall include all indoor and outdoor lighting (including for parking, garage, and other unenclosed areas) for area and task lighting, including refrigerated case lighting.
- h. "Plug loads" shall include loads that are normally served through electrical receptacles but do not include either task lighting or equipment used for HVAC purposes. Plug loads shall include office equipment, audio and video equipment, personal computers, printers, and reprographic equipment and appliances.
- i. "Process loads" shall include loads on the building resulting from the consumption or release of energy consumed in support of a manufacturing, industrial, or commercial processes (not including loads listed in other parts of this section, such as SHW/DHW, or loads resulting from conditioning spaces). Process loads shall be itemized if the energy consumed exceeds 5% of total building energy consumption. Process loads may include, but are not limited to, compressed air, food service, laundry, pool pumps, pool heat, process conveyors, lab equipment, food processing, manufacturing tools, refrigeration that supports manufacturing, or other.
Informative Note: While the scope of this standard excludes industrial processes, in some commercial buildings, the base load from these processes may be included in the end-use breakdown if needed to account for base-case energy consumption.
- j. "Refrigeration" shall include compressors, condenser fans, condenser water pumps, walk-in coolers, freezers, refrigerated cases (self-contained or remote), refrigerated storage, household refrigerators, and process cooling.
- k. "Cooking" shall include all primary cooking and food storage equipment, such as ovens, stoves, steamers, fryers, food warmers, and cold tables.
- l. "Information technology" (IT) shall include all centralized equipment for data storage, processing, uninterruptible power supplies (UPS), power conditioning, and IT-related temporary power and access but does not include personal or desktop computers or office equipment.
- m. "Other" shall include miscellaneous loads not listed above, including, but not limited to, distribution transformer losses and pumps or motors that are not included in categories above.
- n. Ventilation is not included as an end-use category in Section 5.4.5.1, to the extent that as its associated energy is included as part of space heating, space cooling, and air distribution categories. However, because ventilation levels can be a major factor in thermal loads, ventilation, including mechanical ventilation and/or ventilation via natural draft infiltration or exfiltration, shall be separately described and assessed. This evaluation shall be based on observation of building details, equipment ratings and operations, and testing as deemed appropriate by the qualified energy auditor. **Informative Note:** See ASTM 1186-03, ASTM E779-10, and CGSB149.15-96 in Informative Appendix I for methods for quantifying envelope air leakage (e.g., pressurization/depressurization, infrared scanning, smoke tracer, anemometer, sound detection, bubble detection, and tracer gas techniques [ASTM 1186]; using a building HVAC system to test for leakage [CGSB-149.15]).

5.4.1.6.3 End-Use System Energy Use Assessment Methodology.

Analyze the energy using systems using one of the following methods. Fuel and electricity con-

sumption units shall be expressed in energy consumption units at the site energy value (not adjusted for power generation and distribution efficiency). End-use system energy consumption shall be determined in accordance with one or more (or a combination) of the following methods:

- a. A calculated method that estimates energy use according to the size, load, method of control, and efficiency of equipment, and its operating hours. Assumptions used in this analysis must be the same as those used for calculations of energy and demand savings.
- b. A building energy model. The same simulation must be used that is used for calculation of energy and demand savings.
- c. Based on sub-metered energy use in the building.

Informative Notes:

- a. For all three approaches, it is recommended that the end-use calculations be normalized for weather dependent systems to ten-year average weather data, when applicable. For this reason, there may be a difference between the end-use breakdown values and the utility bills reflective of the difference between the ten-year average weather data and the period that metered energy use for the audit was collected.
- b. ASHRAE Procedures for Commercial Building Energy Audits provides guidance for estimating energy use by end use.

<https://www.ashrae.org/technical-resources/bookstore/procedures-for-commercial-building-energy-audits>

5.4.1.6.4 Distributed and Renewable Energy Resource Opportunity.

The qualified energy auditor shall conduct a qualitative overview assessment of the site's opportunities for all feasible distributed energy resources (DERs) and renewable energy resources (RERs); ~~including, at minimum, one technology of each type.~~ For multifamily housing, this requirement shall also include solar thermal (such as SHW/DHW). The qualified energy auditor shall assess the feasibility of each technology. Where a technology is judged by the qualified energy auditor to be feasible, the assessment shall include an estimate of the system size, configuration, savings, cost, and simple payback. The assessment shall consider relevant site factors for each technology, including, but not limited to the following:

- a. Building orientation, neighboring features, and shading
- b. Available roof and other space available for equipment
- c. Thermal and electric loads
- d. Electric metering configuration

~~The qualified energy auditor shall assess the feasibility of each technology. Where a technology is judged by the qualified energy auditor to be feasible, the assessment shall include an estimate of the system size, configuration, savings, cost, and simple payback. For cogeneration, the assessment shall estimate the system size based on operation with usable heat recovery for at least 75% of operating hours.~~

Informative Note: Commonly considered DERs include thermal and electric storage. Commonly considered RER include wind, solar photovoltaics (PV). Geothermal could be considered a DER or RER depending on the application.

5.4.1.7 Initial Measures List.

List potential energy saving opportunities for each system included in the facility site survey (see Section 5.4.1). Conduct preliminary calculations to estimate the range of savings and costs in order to help guide decisions on which measures should be pursued for full analysis. Summarize the results in an initial measures list. The list of measures shall be completed or, at a minimum, reviewed by the qualified energy auditor, and the preliminary calculations shall be conducted or reviewed by the qualified energy auditor.

Informative Note: The building owner might request a discounted or undiscounted financial analysis. A discounted financial analysis considers the time value of money which is ignored in an undiscounted analysis.

5.4.1.8 Calculate Energy Savings

5.4.1.8.1 Energy Use Impacts.

For each measure or group of measures, identify key energy uses that will be impacted by the improvement, by energy source type (electricity, gas, etc.).

5.4.1.8.2 Calculation Method.

Select the methodology of calculation: stipulated values, engineering calculations, building energy model, or other.

5.4.1.8.3 Evaluation of Individual Measures.

Using a preliminary cost estimate (see Section 5.4.8), provide a separate calculation (or building energy model run) for each individual measure. Measures may be grouped, if desired, in consultation with the building owner to best suit the owner's criteria. Maintain a record of these individual measures and group calculations for inclusion in the audit report.

5.4.1.8.4 Interactive Effects.

Analysis of measures and/or measure groups shall include interactive effects. Identify interactions between measures or groups of measures and account for the interactions between the measures.

5.4.1.8.5 Requirements for All Calculation Methods.

The same energy analysis method shall be used for base case and proposed case calculations. Energy savings shall be calculated as the base-case energy use minus the proposed-case energy use. Assumptions shall be noted, and any change in assumptions between base-case and proposed-case calculations shall be documented.

Energy savings by end use shall be compared to estimated values for the same end uses in the end-use breakdown (see Section 5.4.4) and the total of all savings to total building energy use to ensure that calculated savings are reasonable.

Weather data used for energy savings calculations shall be long-term (minimum ten year) average data.

Equipment performance characteristics shall take into account part-load or seasonal efficiencies where applicable. Full-load efficiencies shall not be used to represent efficiency across all load conditions for equipment with varying part-load or seasonal efficiencies.

Equipment operating schedules and hours of operation shall be based on building operations. Runtime meters shall be used if schedules cannot be established by other means. For each metered or delivered energy source, a marginal unit energy price shall be calculated. Energy cost savings shall be based on the marginal costs and demand charges. Use of average unit cost (blended rates) is prohibited. For seasonal or time-of-use rates, an algorithm shall be developed to reflect the actual rate. For real-time commodity pricing, a seasonal algorithm shall be developed based on historical data.

Informative Note: Key parameters used for calculations should be verified during the Site Survey. Parameters for calculations that use actual equipment performance and schedules on-site is recommended. Information entirely based on a Remote Assessment does not meet this requirement.

5.4.1.8.6 Additional Requirements for Building Energy Models.

The simulation software shall meet or exceed the requirements of ASHRAE Standard 140 or be specifically approved by the AHJ.

5.4.1.9 Estimate EEM Costs

5.4.1.9.1 EEM Cost Estimates

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

- a. Material costs
- b. Labor costs
- c. Design fees
- d. Construction management
- e. Site-specific installation factors
- f. Permits
- g. Temporary services

- h. Testing, adjusting, and balancing
- i. Utility service upgrades
- j. Commissioning
- k. Taxes
- l. Profit
- m. Any additional adjustments that significantly impact the cost estimate of the EEM

Informative Notes:

- a. Multiple measures affecting the same building systems or end uses may be combined and their costs estimated as a group. Combining costs may improve the cost-effectiveness of combined measures.
- b. EEM costs may be determined as:
 - I. Total implementation costs, which include all costs associated with replacing equipment at the end of useful life, or,
 - II. Incremental cost, calculated as the additional cost of an EEM over any routine or scheduled equipment replacement. When this method is used, one must also determine total implementation cost.

The AHJ may determine if the EEM costs need to be incremental or total implementation costs.

5.4.1.9.2 Hazardous Material Abatement.

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

5.4.1.10 Conduct Economic Analysis.

Measures may be grouped according to end use, system type (lighting, HVAC, etc.), cost (low, medium, and high), or by other means as requested by the building owner or their representative. Each measure shall be assessed for financial benefits separately at first. Afterward, packages of measures shall be developed, if appropriate, after discussion with the facility owner.

Identify and quantify available incentives from any local utility or government programs. Identify and quantify applicable tax credits.

Calculate the simple payback and simple ROI of each practical measure, based on the total expected costs. If the measures are grouped, the simple payback and simple ROI of the group of measures, including all expected costs and quantifiable ancillary benefits, may also be estimated.

Note the ancillary benefits of each measure or group. Ancillary benefits may include improved thermal comfort, reduced maintenance costs, reliability, aesthetic improvement, improved indoor light, improved air quality, reduced water use, or other factors. Where possible, quantitatively estimate the ancillary benefits.

Identify the measures that meet the owner's criteria, whether individually, or in aggregate. Assess which measures may be reasonably combined and assessed as a group. Calculate each group's simple ROI.

5.4.1.11 Quality Assurance Review.

A quality assurance review shall be conducted to evaluate the feasibility and appropriateness of identified measures, as well as the reasonableness of energy savings projections, implementation cost estimates, and all observations and findings of the energy audit.

The qualified energy auditor shall ensure that recommended measures are feasible and appropriate for the subject building considering the existing equipment, building occupancy, and owner's economic requirements. The qualified energy auditor shall compare the energy savings, costs, cost savings, and ROIs for each measure to expected ranges for the type of measure specified to verify reasonableness. Results outside of

expected ranges shall be explained in the audit report or corrected as required.

Savings calculations using spreadsheet analyses or other methods shall be validated by calculating the percent savings of each measure and the total combined measures in relation to total energy use of the relevant end-use categories.

Where building energy modeling is used to conduct savings calculations, the model shall be calibrated to ASHRAE/ACCA Standard 211-2018 (RA 2023)

brated per the methodology in ASHRAE Guideline 14 with respect to the building's actual energy use.

5.4.1.12 Review EEMs with Owner's Representative.

Provide the owner or their appropriate representative a list of identified measures and their brief descriptions; energy, energy costs, and nonenergy cost savings; available incentives; simple ROI; and simple paybacks.

The qualified energy auditor shall review with the building owner's representative the measure list and implications of each individual measure, including their quantitative impact, ancillary benefits, and ongoing costs. Recommendations for measure groupings and their savings, costs, and economic performance shall be reviewed and an opportunity provided for the owner or owner's representative to comment and to direct which measures to recommend and how to present the financial analysis.

The qualified energy auditor shall provide the owner or owner's representative the opportunity to comment about which measures are preferred for implementation or further study.

After the review with the owner or owner's representative, the audit shall be revised to show any changes in the recommended measures, measure groups, and measures identified but not recommended.

5.4.2 Decarbonization Assessment Procedures

The decarbonization assessment must be done after completion of, or in conjunction with, the energy audit. A Level 2 decarbonization assessment shall include all of the procedures contained in Level 1 decarbonization assessment and a Level 2 energy audit scope, as specified in Section 5.3.2 and 5.4.1, as well as the following requirements.

Informative Note: Section titles from Section 5.4.1, *energy audit* procedures, are duplicated below in order to preserve consistency with numbering. When the *decarbonization assessment* procedures align with the *energy audit* procedures, the appropriate section within *energy audit* procedures has been referenced. When the *decarbonization assessment* procedures differ from the *energy audit* procedures, the appropriate requirements have been added to the relevant section.

5.4.2.1 Energy Cost Component Breakdown.

As defined in *energy audit* procedures specified in Section 5.4.15.4.1.1

5.4.2.2 Facility Site Survey

As defined in *energy audit* procedures specified in Section 5.4.15.4.1.2

For all major equipment on site, the remaining useful life shall be identified.

The QDA shall review the building electrical infrastructure to understand whether the electrical system can accommodate the increased electrical loads. The QDA shall identify the building electrical service capacity and the size and rating of the main electrical panel. Additionally, the QDA shall identify the major existing electrical loads and peak demand.

The QDA shall assess electric vehicle supply equipment (EVSE) when present or conduct an electric vehicle readiness assessment for fleet vehicles generated Scope 1 emissions.

Informative note: The comparison of the peak demand against the building service capacity can help identify whether the existing service can handle new electrification loads. An assessment of the main electrical panel, its age and condition can identify if the panels need upgrading to support additional electric loads. The QDA may identify if utility upgrades might be required to support electrification.

[Note for Reviewers: SSPC 211 would appreciate input on this section]

5.4.2.3 Review of Current O&M Procedures.

In addition to the *energy audit* procedures identified in Section 5.4.1.3, collect information about additional non-energy items, including refrigerant using equipment, refrigerant losses and identify refrigerant management practices.

Informative note: Section 5.2.3.2.1 provides guidance on calculating GHGI and GWP.

5.4.2.3.1 Refrigerant Management and Maintenance

The QDA shall identify and document all major equipment at the building that uses refrigerants. For all comfort cooling, commercial refrigeration, or other process cooling equipment that has a refrigerant gas charge of at least 5 lbs of refrigerant, the QDA must record the following:

- a. Type of equipment:
 - Air cooling (air dryer/dehumidifier, air handling unit, chiller (centrifugal, screw or scroll), data/IT cooling, heat pump (air source, water source, or VRF), package unit, rooftop unit, split system – single, split system – multi, other)
 - Commercial refrigeration (beverage system, ice machine, refrigeration rack, reach-in cooler, condensing unit)
 - Process cooling: chiller, cooler, freezer, lyophilizer, refrigerator, ultra-low temp freezer, other)
- b. For each piece of equipment over the threshold size, provide where information is readily available:
 - Cooling capacity
 - Refrigerant type
 - Gas capacity (lbs; the total intended charge/full charge)
- c. Charge capacity source type (measured, calculated, nameplate)

The QDA shall document, from sources such as purchase records, refrigerant volume and type and related GWP value for all refrigerants brought into the building to replace losses over the past 24 months. From such records the QDA shall convert these into CO2e emissions.

The total of all refrigerants annualized average over the 24 month period shall be compared to total refrigerant in major systems (as defined above) in the building, to determine the leak rate for the building. If the annualized leak rate is above 10% of the total refrigerant charge in the building then the DA must include an ERM to identify and repair such leaks.

Informative Note: Additional information on documenting inventory of refrigeration equipment is in the Climate Friendly Refrigerant Inventory Workbook developed by the US Energy Foundation and IGSD, available at <https://form.jotform.com/252544524079157>. Helpful guidance is available in the Climate Friendly Refrigerant Management Guide published by the Sustainable Purchasing Leadership Council, <https://form.jotform.com/252543545216152> (information on both the Inventory Workbook and the Guide at <https://www.sustainablepurchasing.org/refrigerants-pcc>).

The refrigerant charge threshold has been defined to exclude typical residential equipment such as domestic refrigerators, vending machines, Window AC units, Mini-split systems below charge threshold, Lab or medical equipment unless central or high-charge

[Note for Reviewers: SSPC 211 would appreciate input on this section, specifically also on the minimum refrigerant gas charge]

5.4.2.4 Determine Key Operating Parameters.

As defined in energy audit procedures specified in Section 5.4.15.4.1.4

5.4.2.5 Building Thermal Load Profile Assessment

The QDA shall use the information collected to identify the following:

- Annual building heating and cooling load profiles using monthly or more granular data
- Peak thermal loads for winter, summer and shoulder seasons (heating, cooling, water heating and any other major thermal needs)
- Estimate of unnecessary simultaneous heating and cooling
- Comparison between peak thermal loads and capacity of equipment serving those loads

Informative note: There are often opportunities to recover heat for use in lower quality thermal needs (e.g., condenser water recovery to pre-heat domestic hot water). A building thermal load profile assessment allows the

assessor to identify potential opportunities to minimize simultaneous heating and cooling and opportunities for heat recovery. Identification of peak thermal loads allows the assessor to identify potential peak load reductions (e.g., envelope improvements, ventilation energy recovery), as well as the extent of oversizing of existing equipment, to enable heating and cooling equipment capacity reduction.

[Note for Reviewers: SSPC 211 would appreciate input on this section]

5.4.2.6 Conduct End-Use and Emissions Breakdown.

The energy use allocation shall be quantified for each end-use system and separated by energy source type in accordance with Section 5.4.1 and reported in accordance with Section 6.2.4.

In addition to quantifying energy use for each end use category, as specified in Section 5.4.1.6, the QDA shall also calculate the Scope 1, Scope 2 and total emissions for each end use and each energy source. The GHG emissions shall be calculated using emission factors, as specified in Section 5.2.3.2.

5.4.2.6.1 Building System End Use Categories

As defined in *energy audit* procedures 5.4.1.6.1.

5.4.2.6.2 End-Use Systems

As defined in *energy audit* procedures 5.4.1.6.2.

5.4.2.6.3 End Use System Energy Assessment Methodology

As defined in *energy audit* procedures 5.4.1.6.3

5.4.2.6.4 Distributed and Renewable Energy Resource Opportunity.

In addition to the energy audit procedures defined in Section 5.4.1.6.4, the QDA shall determine the potential impact on GHG emissions for strategies identified to be feasible for implementation.

5.4.2.7 Initial Measures List.

In conjunction with the building owner, determine target time horizon for initial EEMs and ERM list for the *decarbonization assessment* and the type of financial analysis to be utilized, including but not limited to life cycle cost, net present value etc.

List potential energy savings and emissions reductions opportunities for each system included in the facility site survey (see Section 5.4.2.2).

Estimate the range of savings and costs in order to help guide decisions on which measures should be pursued for full analysis.

Conduct preliminary assessment of potential enabling steps, including but not limited to the identification of major equipment that is expected to require replacement due to its remaining useful life in order to help guide decisions on which measures that may not otherwise have near-term economic benefit should still be pursued for full analysis.

Summarize the results in an initial measures list. The list of measures shall be completed or, at a minimum, reviewed by the QDA, and the preliminary calculations shall be conducted or reviewed by the QDA.

Informative Notes:

- a. The building owner might request a discounted or undiscounted financial analysis. A discounted financial analysis considers the time value of money which is ignored in an undiscounted analysis.
- b. Other potential enabling steps may include trigger events such as tenant turnover, lease term amendments, fines or penalties associated with non-compliance with jurisdiction's policies. These steps should support the development of longer-term measures for an eventual strategic decarbonization plan over a specified timeframe.
- c. The timeframe for implementation should consider potential enabling steps for longer term measures for eventual deep, decarbonization plan, including but not limited to, short-term operations and maintenance, next-year capital planning and longer-term building life cycle.

5.4.2.8 Calculate Energy Savings and Emission Reduction

5.4.2.8.1 Energy Use and Emissions Reduction Impacts.

As defined in *energy audit* procedures 5.4.1.8.1.

Identify whether the measure impacts Scope 1 emissions, Scope 2 emissions or both.

For each measure or group of measures, identify key energy uses that will be impacted by the improvement, by energy source type (electricity, gas, etc.).

5.4.2.8.2 Calculation Method.

As defined in *energy audit* procedures 5.4.1.8.2.

Select the methodology of calculation: stipulated values, engineering calculations, building energy model, or other.

5.4.2.8.3 Evaluation of Individual Measures.

As defined in *energy audit* procedures 5.4.1.8.3.

Analyze ERM to identify potential opportunities for building peak electric and thermal load reductions, electrification, reduction of fugitive emissions, renewables, etc. Identify potential decarbonization-enabling steps, including but not limited to the identification of major equipment that is expected to require replacement due to its remaining useful life.

Translate EEM and ERM energy savings into GHG emission reductions. The GHG emission reductions shall be broken out by Scope 1 emissions and Scope 2 emissions.

Informative Notes:

- d. Other potential enabling steps may include trigger events such as tenant turnover, lease term amendments, fines or penalties associated with non-compliance with jurisdiction's policies. These steps should support the development of longer-term measures for an eventual strategic decarbonization plan over a specified timeframe.
- e. Using a preliminary cost estimate (see Section 5.4.1.9), provide a separate calculation (or building energy model run) for each individual measure. Measures may be grouped, if desired, in consultation with the building owner to best suit the owner's criteria. Maintain a record of these individual measure and group calculations for inclusion in the assessment report.
- f. Section 5.2.3.2.1 provides information for calculating GHG emissions.

5.4.2.8.4 Interactive Effects.

As defined in *energy audit* procedures 5.4.1.8.4.

Analysis of measures and/or measure groups shall include interactive effects. Identify interactions between measures or groups of measures and account for the interactions between the measures in estimated energy savings and emission reductions.

5.4.2.8.5 Requirements for All Calculation Methods.

As defined in *energy audit* procedures 5.4.1.8.5.

The same energy savings and emissions reduction analysis method shall be used for base case and proposed case calculations. Energy savings and emissions reductions shall be calculated as the base-case energy use minus the proposed-case energy use. Assumptions shall be noted, and any change in assumptions between base-case and proposed-case calculations shall be very clearly documented.

Energy savings and emissions reductions by end use shall be compared to estimated values for the same end uses in the end-use breakdown (see Section 5.4.2.6) and the total of all savings to building energy use and reductions to total building emissions to ensure that calculated savings and reductions are reasonable.

Weather data used for energy savings and emissions reductions shall use the same methodology as energy savings calculations, and shall be long-term (minimum ten year) average data or add permitted by the AHJ. Equipment performance characteristics shall take into account part-load or seasonal efficiencies where applicable. Full-load efficiencies shall not be used to represent efficiency across all load conditions for equipment with varying part-load or seasonal efficiencies.

Equipment operating schedules and hours of operation shall be based on building operations. Runtime meters shall be used if schedules cannot be established by other means.

For each metered or delivered energy source, a marginal unit energy price shall be calculated. The QDA shall state whether they're using marginal or annual average emission factors in their emission calculations, along with the source of the emission factors, as specified in Section 5.2.3.2.1.

Informative Note: If projecting electric grid emissions (and district energy) factors into the future,

and the impact on annual GHG intensity metric going forward, cite sources and assumptions for emissions conversions projections.

5.4.2.8.6 Additional Requirements for Building Energy Models.

As defined in *energy audit* procedures 5.4.1.8.6.

5.4.2.9 Estimate EEM and ERM Costs

As defined in *energy audit* procedures 5.4.1.9.

5.4.2.10 Conduct Economic Analysis.

As defined in *energy audit* procedures 5.4.1.10.

The decarbonization assessment financial analysis shall estimate the following costs over a planning time horizon determined by the building owner, including the estimated year of each expense: The costs shall be estimated at current-equivalent dollars

- a. Total cost or incremental cost to implement recommended group of EEMs and ERMs
- b. Anticipated fees or fines, if any, from noncompliance with BPS
- c. Annual cost of energy from each energy source
- d. Annual incremental maintenance costs.

Informative note: The AHJ may determine if the EEM and ERM costs need to be incremental or total implementation costs. The building owner may choose to determine the planning time horizon based on long term decarbonization goals for net zero emissions or compliance cycles for building performance standards.

5.4.2.11 Quality Assurance Review.

As defined in *energy audit* procedures 5.4.1.11.

5.4.2.12 Review EEMs and ERMs with Owner's Representative.

Provide the owner or their appropriate representative a list of identified measures and their brief descriptions; energy, energy costs, and nonenergy cost savings; CO₂e, impacts; available incentives; simple ROI; and simple paybacks.

The QDA shall review with the building owner's representative the measure list and implications of each individual measure, including their quantitative impact, ancillary benefits, and ongoing costs. Recommendations for measure groupings and their savings, costs, and economic performance shall be reviewed and an opportunity provided for the owner or owner's representative to comment and to direct which measures to recommend and how to present the financial analysis.

The QDA shall provide the owner or owner's representative the opportunity to comment about which measures are preferred for implementation or further study.

After the review with the owner or owner's representative, the *decarbonization assessment* shall be revised to show any changes in the recommended measures, measure groups, and measures identified but not recommended.