

TCAC Existing Multifamily Assessment Protocols

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Assessment Objectives

This document has been created for California Tax Credit Allocation Committee (TCAC) project submittals to ensure a consistent approach to the evaluation of existing multifamily buildings. These protocols define assessment and testing requirements for existing multifamily buildings along with professional qualifications required to complete the work. In addition, there are *optional* levels of evaluation and analysis in an appendix which are recommended but not required.

The objective of the assessment is to evaluate the entire building and all of its associated systems in order to identify deep energy and water savings opportunities while also addressing indoor environmental quality opportunities that align with the planned scope of work. The recommendations in the report should be integrated into the design process and associated design documents.

TCAC Documents

There are several resource documents available for TCAC submittals. The documents and resources fall into two categories: reference documents and required documents for submittal. They are as follows:

Reference Documents

Regulations: Stipulate the requirements of the TCAC program.

TCAC Existing Multifamily Assessment Protocols: Defines the elements and the process of completing an assessment that meets the requirements of the TCAC regulations, which is this document.

Required Documents for Submittal

TCAC Existing Multifamily Assessment Report: The report template is an editable word document for a report that meets the requirements of TCAC regulations. The report submitted at the time of application shall be submitted in this format. The report documents the evaluation and recommendations of the assessor. This is required for the application phase.

TCAC Sustainable Building Methods Workbook: This Excel document is a requirement for submittal and includes all necessary calculations to meet requirements for application and placed in service phases.

Performance Improvement Targets

The Assessment process will:

- Identify and quantify specific opportunities to achieve a minimum 10% TDV reduction in whole-building energy use over existing conditions by specifying a portfolio of measures. The 10% TDV is the minimum construction requirements for all projects. See TCAC regulations Section 10325(f)(7)(A).

Savings should be reported in TDV and Site energy to facilitate the use of the report across multiple programs. The threshold for improvement may vary between TCAC and other programs

- For projects going beyond the minimum construction requirements, refer to the Workbook sheets *New Construction Point Scoring* and *Rehabilitation Point Scoring*.

Building Type Definitions

Multifamily buildings are defined by TCAC as buildings that contain at least two dwelling units within the same building envelope. For TCAC, multifamily buildings are categorized as follows:

- Low-rise Multifamily: Two or more attached dwelling units with less than four habitable stories.
- High-rise Multifamily: Two or more attached dwelling units with four or more habitable stories.
- Mixed-use Multifamily: Two or more attached dwelling units as well as non-residential spaces within one building envelope.

A multifamily project is one that is under the one management as a single property. The buildings may be located on a single lot or scattered lots.

These categories can be further disaggregated by ownership structure and metering configuration (central vs. individual). Although these subcategories may impact the decision-making process for energy improvements, for the purpose of conducting the Assessment, the primary distinction is in the multifamily sub-categories described above and between residential and nonresidential spaces:

Residential Spaces: For energy modeling purposes, residential spaces are defined as apartment units and corridors serving apartments (areas used to access the units) are residential space. Common areas (common space, office space, laundry areas) in a residential building are included if the common area total is less than 20% of the floor area.

Nonresidential Spaces: Common area other than corridors that exceed 20% of a building's area must be modeled as nonresidential space. Buildings such as community buildings and laundry buildings that are utilized by tenants but contain no residential dwelling space may be included in the modeling as nonresidential space, using a nonresidential modeling software.

Retail or commercial space shall not be modeled, either as a separate building or floor space in a multi-story building.

The definitions of a multifamily building and modeling requirements may vary between programs. If a project is participating in multiple programs, it is important to confirm these eligibility requirements to ensure the project can successfully participate in multiple programs.

Reference Standards

These Assessment Protocols are derived from the following reference standards:

- Title 24 Standards for Residential and Non-residential Buildings (2008)
- HERS II Technical Manual (2008)
- Building Performance Institute, Inc., Technical Standards for Multifamily Building Analysts (2008) and (2013 draft standards)
- HUD, Energy Conservation for Housing: A Workbook (1998)
- RESNET, RESNET Standards, Chapter Seven, Comprehensive Home Energy Assessment
- ASHRAE, Commercial Building Assessment Standards (2004)
- Enterprise San Francisco Bay Area Affordable Multifamily Retrofit Initiative Assessment Protocol
- City of Berkeley Money For Energy Efficiency Assessment Standard
- GreenPoint Rated Existing Home Multifamily Program
- Multifamily Home Retrofit Coordinating Committee – Opportunities and Recommendations for Green Retrofit and Rehab Programs (2011)

Assessment Team Qualifications and Responsibilities

Assessor Qualifications

The Assessor shall have minimum qualifications as specified in the tables below. To fulfill the tasks listed in these tables, the Assessor may assemble multi-disciplinary teams consisting of employees or contracted partners. The Assessor shall ensure that its personnel and any contractors assigned to perform services have the necessary qualifications, licensing, bonding, insurance, competence, skill sets and experience required to fulfill their respective responsibilities.

Required Assessor qualifications for all multifamily projects

Tasks	Minimum Qualifications
Energy modeling and utility data analysis	California Association of Building Energy Consultants (CABEC) Certified Energy Plans Examiner (CEPE)- Res CEPE ID for 3 stories or less and Non Res CEPE ID for 4 stories or more and Whole House Rater
Whole building energy assessment and recommendations (professional must have two of the three)	<ul style="list-style-type: none"> • HERS Whole House Rater • BPI Multifamily Building Analyst • GreenPoint Rater for Existing Multifamily

Assessor Responsibilities

- Performance: Complete the work and provide the deliverables as specified in these Assessment Protocols
- Materials: Assessor will obtain and/or provide any and all equipment required to provide the Assessment services, such as computers, cameras, thermal imaging devices, software, meters, measuring devices, and pressure gauges.
- Methods: Assessor shall comply with all local safety and security requirements and perform all onsite work in coordination with the designated local point of contact.
- Assessment or Conduct Standards: Assessor/ Assessment Company shall comply with applicable professional standards for ethics as defined by the Building Performance Institute Code of Ethics.
- Report Generation and Representation: An officer or owner of the firm conducting the Assessment shall certify in writing that the Assessment meets these Assessment Protocols without exception, unless specifically exempted, and that the final Assessment Report has been reviewed for quality assurance purposes by a principal or officer of the firm.

Building Owner/Client Responsibilities

The property owner or client is responsible for providing the following, if requested by the Assessor:

- Available mechanical and electrical as-built drawings
- Available energy management and control system documentation and drawings
- Energy cost and use data or authorization to obtain such data including:
 - o Utility service agreement identification numbers for all common area gas and electric service (when feasible)
 - o One year of client's monthly building natural gas and electric utility data

Sampling Protocol¹

[This material was excerpted from Section 2.5 of the Technical Guidelines for Multifamily Building Energy Audits for the DOE Weatherization Assistance Program and edited to support the scope of the Assessment for TCAC.]

Sampling is important, but understanding the building is the primary objective. Inspection and testing of each dwelling unit in a building is typically difficult. Before conducting the energy assessment, the potential need for sampling must be determined. It may depend on the size of the building(s), potential issues with tenant dwelling access, or cost implications. On-site sampling is involved in two general activities:

1. Sampling of apartments/buildings for inspection, testing, and analysis
2. Sampling of equipment such as furnaces, refrigerators, hot water heaters, or lighting to understand installed characteristics and operation

An adequate sampling plan should be established for every project. The sampling plan should define the number of dwellings required for energy modeling, different types of testing, and different types of inspections. The means of notifying residents and obtaining access to dwellings to be inspected must be established and residents informed. The plan should identify requirements for sampling of common spaces. It is not required that a written sampling plan be submitted to TCAC but evidence that adequate sampling has been performed should be presented in the Assessment Report.

Sampling introduces uncertainty. There are complicated methods for providing statistical expressions of uncertainty (e.g., Appendix B of Vol. 1 of the International Performance Measurement and Verification Protocol, 2007, 2010, or 2012 version, www.evo-world.org). These methods are needed in some cases, but they depend on knowing key statistical values (all of which will not be known for some approaches), so the Technical Guidelines for Multifamily Building Energy Audits for the DOE Weatherization Assistance Program recommends keeping sampling methods simple. Simple sampling guidelines are presented that provide a balance between managing uncertainty and managing the costs of the assessment.

Guidance on sampling requirements is presented primarily for individual buildings. Sites with multiple buildings may require many decisions about sample plan requirements based on best judgment. Guidance for those cases is more general. The entity to be sampled may vary, depending on what is easiest to do. For dwelling units, the sampled entity is usually the dwelling unit or the specific piece of equipment in the unit. For common spaces, the sampled entity may be square feet of floor area.

Table 1. Recommended number of units to sample based on total number of units in a building

Building size (total number of units)	Number of units to sample	
	Minimum	Recommended
2 – 9	2	3
10 – 19	3	5
20 – 29	4	7
30 – 49	5	9
50 – 74	6	11
75 – 99	7	13
100 – 149	8	16
150 – 200	9	20
>200	10	25

¹ The sampling protocols align with Technical Guidelines for Multifamily Building Energy Audits pending publication. MacDonald, Michael; Mini Malhotra; and Mark Ternes. "Technical Guidelines for Multifamily Building Energy Audits." ORNL/TM-2014/0297 (DRAFT). Oak Ridge National Laboratory. April 2014 (Draft).

The most important aspect of reducing uncertainty in sampling is to have the sample be as representative of the entire population as possible—the more representative, the less potential for sampling bias error. Sampling of the buildings and units should be described in the Assessment Report.

Individual Buildings

Dwelling units: These recommendations cover buildings with two or more dwellings. The sampling statistics depend on the variability in the population, which will not be known before the site visit. The minimum number of dwelling units to be sampled can be found in Table 1, although more units may be better. The minimum column is for difficult cases; the recommended value should be the target. Interpolation is needed for larger buildings.

In addition, the sampling plan should define the following:

- Sampling should include a representative cross section of units within the building; e.g., if units vary in size, the sample should reasonably represent all sizes and locations (top, bottom, inner, outside) to the extent possible.
- Units in the audit sample should undergo a uniform scope of inspections and diagnostic testing.
- Sample sums must be extrapolated up to account for the whole building in order to analyze the whole building; i.e., if 5 units are sampled in a 12-unit building, the simple extrapolation is to multiply summed values (such as for energy use) by 12/5 to obtain a value for the whole building.
- If excessive variation for some (normalized) results is found for the sample, the sample may need to be expanded (extended sample set), at least for the problem area, to obtain acceptable results.

For in-unit heating, cooling, and water-heating equipment efficiencies, capacities, and operational modes, an average of the sample for specific types may be used for the whole building or type of space in the building. Lighting power density and equipment power density are also averaged, either for the whole building or space type or by floor. Water use per person or per dwelling, and temperature values, are averaged. Infiltration and ventilation should be handled according to the specifications of the energy modeler. The data may be a whole-building average based on the sample average, or it may be determined by floor and then the values calculated, or possibly interpolated, by floor.

Common spaces: The common space sampling is proportional to the number of floors.

For hallways:

- In buildings having 1–4 stories, hallways should generally all be inspected. Then the average parameters needed for energy modeling and energy measure determination should be calculated using the most representative data.
- For buildings of 5–20 stories, hallways on at least half the floors (rounding up for odd values, or 3 floors for a 5-story building) should be inspected.
- In buildings taller than 20 stories, hallway inspection can be based on elevator layouts, if elevator banks have floor series (e.g., one bank serves floors 1–24 and one bank serves 24–48).
- In general, at least 10 floors should be inspected. For multiple banks, an equal number from each bank should be inspected, preferably at least 10, up to half of the floors on each elevator bank.

For Stairways:

- In low-rise buildings (3 stories or less), every interior stairwell should be inspected, with special attention paid to the top and bottom of each.
- In buildings taller than three stories, the top and bottom of every interior stairwell should be inspected, and any exterior façades of interior stairwells should be examined before deciding which stairwells to inspect further. Interior stairwell inspections in these building should include 40% of the stairwells in each building (or a minimum of one) and should cover at least 25% of the total floor area of each one inspected. In a building with seven stairwells, at least three should be inspected and at least 25% of the floor area of each (for a building with six stairwells, two would be inspected further).

Meeting rooms, day rooms, fitness facilities, and office space might all be aggregated as “other” for analysis, but all “other” spaces need to be visited to obtain data to at least ensure that the aggregated space is a representative average for energy measure evaluation.

Garages might need only limited inspection, but a reasonable determination of total floor area often is needed for lighting power density calculations.

Exterior lighting can be sampled on an ad-hoc basis, although some type of normalizing factor, such as per floor or per foot of perimeter is often helpful. Parking lot lighting is often easiest to handle on the basis of watts per square foot of parking area and can be sampled on an ad-hoc basis at the site to best represent such lighting overall.

Multiple Building Sites

Sites with multiple buildings may have only a sample of buildings inspected and tested. If a central plant exists, that plant should undergo a thorough inspection and diagnostics as needed, unless it is specifically excluded by the audit scope. Other unique buildings may also require a specific inspection and testing as part of the site visit if they are included in the audit scope. For dwelling unit buildings, the guidance is as follows.

- For properties containing multiple buildings the number of units to be sampled will be determined based on the total number of units on the property (using Table 1). Units from more than one building should be inspected and tested. The exception would be if one building is considered to represent the overall site well. In that case, it may be that the site visit would cover only one building. However, it is still advisable to try to include units from different buildings in the sample set.
- If multiple building types are present at the site, the site visit should cover at least one of each type (e.g. height, orientation, structure, year built, floor plan, major upgrades), or the most representative mix of buildings.
- If a site has more than 24 buildings, at least 10% of them should be inspected (e.g., if there are 25–34 buildings, the site visit should cover at least 3).

Site Visits²

The purpose of the site visit is to collect all necessary information to conduct an appropriate energy, water, health and environmental analysis, including sufficient information to inform an energy model. The Assessment shall include an in-person visit to the project site by a qualified Assessor. To ensure a successful site visit and data collection, the following tasks should be completed:

1. Preparation, Scheduling and Tenant Notification
2. Project Interviews
3. Health and Safety Observations
4. Visual Inspections and Diagnostic Testing

1. Site Visit Preparation, Scheduling and Tenant Notification

In preparation for the site visit, the following should be completed.

- Assessor shall review the building's eligibility to participate in the program.
- Assessor should review 12 months of prior utility bills (including gas, electric and water) to know annual utility cost by fuel type and seasonal variations.³
- Assessor should review as-built drawings (if available) and any other pertinent information about the site, the building and its systems, to be provided by the property owner or owner's representative or available on-line.⁴
- Assessor shall communicate requirements of site visit and schedule the site visits with the owner's representative at a time convenient for that person. The site visit shall seek to cause minimal disruption to the project's residents and neighbors.
- The property owner shall notify residents whose units will be inspected as part of the Assessment. This notification shall be the sole responsibility of property owner or their representative.

2. Project Interviews⁵

The Assessor shall interview at least one of the following persons prior to or at the time of the site visit:

- Property manager
- Maintenance director or maintenance staff
- Owner or owner's representative

The purpose of the interviews is to:

- Discuss the Assessment's objectives and the client's goals for the scope of retrofit
- Discuss building characteristics, existing documentation, and project energy and water performance
- Discuss residents' comfort, health and safety and agree on an approach to dwelling unit spaces for the site visit.
- Discuss operations and maintenance procedures
- Address any other stakeholder questions or concerns

² Refer to section 3.5 of *Building Performance Institute's (BPI) Multifamily Building Analyst Professional Technical Standards*.

³ Refer to section 1.7 of the *Building Performance Institute's (BPI) Multifamily Building Analyst Professional Technical Standards*.

⁴ Refer to section 1.8 of the *Building Performance Institute's (BPI) Multifamily Building Analyst Professional Technical Standards*.

⁵ Refer to section 1.9-1.13 of the *Building Performance Institute's (BPI) Multifamily Building Analyst Professional Technical Standards*.

3. Health and Safety Observations⁶

If, during the course of the site visit, the Assessor observes a condition issue that, in his or her judgment, may be a potential threat to health or safety, the Assessor shall notify the designated persons in the project application and/or any individuals that are present representing the owner. Code compliance is not a responsibility of the assessor. In the event, the assessor has the knowledge; any observations may be shared with property owner.

4. Visual Inspection and Diagnostic Testing

The site visit shall involve visual inspections and diagnostic testing of the building envelope, domestic hot water, HVAC, and lighting systems.⁷ The equipment specifications will be used in the energy modeling and analysis phase of the Assessment. The assessor shall complete visual observation and diagnostic testing to be able to make recommendations for energy savings.

Mandatory Energy Efficiency

Project must achieve at least a 10% reduction in whole-building energy use (TDV) as demonstrated by the energy model as required by the TCAC minimum construction standards. See TCAC regulations Section 10325(f)(7)(A). For projects going beyond the minimum construction requirements, additional points may be earned by meeting higher thresholds as identified in the Performance Improvement Targets section of this document as well as TCAC Regulation Section 10325(c)(6) and CDLAC Regulation Section 5230.

Assessor shall identify opportunities to reduce energy used for space heating, space cooling, HVAC systems, domestic hot water systems, pumps, fans, appliances and lighting.

Prescriptive Weatherization

Because of the cost, technical complexity, and limited data to process results from blower door envelope leakage tests, these are not required on multifamily properties. Accordingly, prescriptive envelope measures are not claimed for credit in the energy performance model. Nonetheless, the evaluation of these opportunities to improve the building envelope shall be documented. The evaluation and recommendation in Assessment Report should address the following:

- Weather stripping on all doors or hatches that lead from conditioned to unconditioned space.
- Dampers doors or other devices to obstruct or block air flow to reduce heat loss through chimneys.
- Visible envelope leaks, including pipe and conduit cuts, window sashes and glass, caulking around frames, sills and other linear joints.

Duct Leakage Test

Duct leakage credit may be taken on a property. Ducts shall be tested before construction begins to be able to claim savings. It is recommended that duct leakage tests be conducted for all systems that have more than 12 feet of supply or return air ducts in unconditioned space. If claiming savings, ducted system leakage should be corrected per the Title 24 protocols and leakage targets for existing buildings, additions and alterations.

⁶ Refer to section BPI 3.4 of the *Building Performance Institute's (BPI) Multifamily Building Analyst Professional Technical Standards*.

Additional Diagnostic Testing

Other HERS verification measures are available for savings provided the measures can be captured in the model, the appropriate documentation is completed and any required pre-construction tests are completed. Examples of tests that do not require a test-in but can be leveraged for savings are quality insulation installation for low-rise and high rise and refrigerant charge testing for low-rise. Credit for some HERS measures may be dependent on the compliance software.

Analysis

Energy Modeling⁸

An energy model shall be completed in accordance with the program's simulation guidelines described in the Sustainable Building Methods workbook.

Sampling Assumptions and Plan

The Assessor's approach to sampling the project for modeling purposes must be described in the Modeling and Assumptions section of the Assessment Report. The sampling rate must align with Table 1 in the Sampling section of this protocol. Deviations due to specific site, property, and/or tenant issues should be clearly stated.

Methods and Assumptions

All major assumptions used to develop the energy model and analysis must be clearly stated in an Appendix of the Assessment Report. Reporting emphasis shall be placed on the assumptions that have the most impact on estimated energy savings.

Occasionally, some building features may be difficult to physically verify, such as the insulation in crawl spaces. When certain building features cannot be physically verified, the values from the default assumptions for existing buildings, in the Title 24 Part 6 Subchapter 9, shall be used as the default conditions in the energy model and analysis.

Any savings accruing from air sealing measures shall not be applied unless it can be demonstrated that the infiltration reduction is between conditioned and unconditioned space.

Current operating schedules verified on-site are to be used for energy and energy cost savings estimates.

Ordering of Energy Efficiency Measures

The loading order of energy efficiency measures in the energy modeling analysis shall be structured so that improvements to the building envelope and interior lighting are modeled prior to improvements to the HVAC system.

The intent of this loading order requirement is to capture all of the potential effects of envelope and lighting energy efficiency measures on cooling and heating loads and subsequent investigation into impact of energy efficiency measures pertaining to HVAC equipment.

⁸ Refer to section 2.11 – 2.17 of the *Building Performance Institute's (BPI) Multifamily Building Analyst Professional Technical Standards*.

Assessment Report

A sufficiently detailed yet succinct report that addresses the scope of the Assessment must be submitted using the Assessment Report Template provided by TCAC including all the sections and content. The template includes the following sections:

- Executive Summary
- Detailed List of Recommended Measures
- Existing conditions – including description, observations, photos and test results
- Evaluated measures
- Disclaimer and Modeling Assumptions
- Appendices
 - o Energy Model Output Reports
 - o Energy Modeling Assumptions
 - o Additional Calculations
 - o Sampling Plan

Mandatory Submittal Forms

- *TCAC Existing Multifamily Assessment Report Template*: This is a requirement for Application Phase. The report template is an editable word document for a report that meets the requirements of TCAC regulations. The Energy Assessment Report must be submitted in this format.
- *TCAC Sustainable Building Methods Workbook*: This Excel document is a requirement for submittal and includes all necessary calculations to meet requirements for Application and Placed in Service Phases.

Appendix of Optional Assessment Protocols

The following sections are optional aspects of Multifamily building assessments and evaluation. These aspects may be folded into future regulations for TCAC.

Optional Water and Green Building Measures

In addition to the required energy assessment and mandatory testing described above, the assessment or has the option of collecting additional data and providing additional analysis to address issues of on-site energy generation, operations and maintenance, water and resource conservation, and indoor/ environmental quality.

On-site Energy Generation

Identify opportunities for onsite energy generation, including photovoltaic arrays, solar thermal collectors, small wind turbines, heat recovery and cogeneration systems.

Operations & Maintenance

Identify operations and maintenance opportunities with demonstrated potential to achieve quantifiable electricity or gas (kWh, kW or therm) savings. This includes activities such as building commissioning, retro-commissioning, building automation systems, central water heating tune-ups and controls, operations and maintenance procedural changes, producing an operations and maintenance manual and related management training.⁹

Water Efficiency, Resource Conservation and Indoor Air Quality¹⁰

Identify opportunities for non-energy utility cost savings, including permanently installed water efficiency measures such as high efficiency toilets, landscaping and irrigation improvements, and recycling facility upgrades.

Identify opportunities upgrades that cannot be modeled such as low-flow showerheads and faucet aerators.

Identify additional resource conservation and indoor air quality opportunities that might not have a financial payback but that will have a lower incremental cost if undertaken at the time of retrofit and that will provide comfort and environmental benefits to residents.

Optional Combustion Appliance Safety Testing Measures

The assessment has the option to identify overall conditions associated with combustion appliances and outline recommended repairs to be included in the scope of work. The use of HERCC Combustion Safety Testing Protocols for Existing Multifamily Buildings and current BPI Technical Standards for Building Analyst Professionals are recommended. Qualified assessor certifications to perform the assessment include BPI Building Analyst or HERS Building Performance Contractor.

⁹ See BPI Building Operator Certification & NAHMA Green Building Operator Certification. For competitive points, TCAC only recognized BPI Building Operator Certification.

¹⁰ See GreenPoint Rated Existing Home Multifamily Program for non-energy measures & verification.

Optional Analysis

The following level of analysis can be beneficial to the property owner in evaluating upgrades.

Utility Bill Analysis

Utility bill analysis can offer information on building energy efficiency and occupant behavior. Analysis must include base load evaluation, seasonal evaluation, and recommendations for energy usage reduction.

If possible, acquire one or two years of utility bills and analyze use the patterns and provide a summary report or assessment to the property owner that discusses baseline loads and recommendations for reduction of utility bills and improvement of comfort.

Financial/Payback Analysis

Additionally, clients may benefit from a financial analysis depending on the schedule of the project. Provide a financial analysis for the selected portfolio of measure that shows the savings to investment ratio (SIR). Depending on the timeframe of the project, the property owner may be going out for bid immediately and this level of analysis is not necessary or informative. Alternatively, a project with a longer planning timeframe may benefit from this level of analysis.

Clearly state all assumptions including discount rate, utility rates, life of the measure, installed cost, incremental costs, interactive effects, etc. Include as credits any applicable rebates, tax credits, grants and loans.