CONNECTICUT HOUSING FINANCE AUTHORITY

Unlocking Solutions, Building Strong Communities.

Connecticut Housing Finance Authority

Construction Guidelines: Energy Conservation & Sustainability

2027

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I. Energy Conservation & Sustainability Guidelines

An objective of CHFA is to maximize financial and sustainability in developments. The Construction Guidelines: Energy Conservation & Sustainability outline the standards for developments funded through CHFA including LIHTC, and are intended to provide guidance for sustainable project planning, procurement of sustainability-related financial incentives through utility companies and the CT Green Bank, and for CHFA Architectural and Construction Services (ACS) (FKA Technical Services) review. In general, sustainable design measure strategies include minimizing non-renewable energy consumption, use of environmentally-preferable products, protecting and conserving water, enhancing indoor air quality and optimizing operational and maintenance practices to create resilient buildings and healthy communities. It emphasizes both the project's front-end (planning, application, award) and back-end (construction, post construction, operations).

Building materials, components, fabrications, assemblies and equipment for proposed development projects including rehabilitations and new construction, shall strive to comply with the applicable sections of the latest "Multifamily Design and Construction Standards – CHFA" (the Standards). CHFA has also developed a series of "Construction Guidelines" to further assist development teams through the application, planning, design and review process. The CHFA "Construction Guidelines: Project Planning & Architectural and Construction Services Review" and the Standards define design recommendations and review process for multifamily housing funded through CHFA and LIHTC. All applicants are encouraged to engage with CHFA ACS during the Pre-application phase to discuss project-specific energy conservation and sustainability issues.

A. Energy Efficiency

CHFA Design and Construction Standards promote thermal efficiency and energy conservation measures in the planning and design of all developments. Development teams are required to prepare and submit an Energy Conservation Plan with the CHFA/DOH Consolidated Application. Detailed Energy Conservation Plan requirements are outlined below.

1. Information regarding local, state and federal incentives for energy conservation may be found through EnergizeCT, Eversource Energy, Connecticut Natural Gas (CNG), United Illuminating, Southern Connecticut Gas (SCG), local municipal utilities, and CT Green Bank. All Applicants should contact the utilities for information regarding rebates and incentives.

2. For new and rehabilitation projects, including equipment replacement, the above noted companies may be able to provide technical assistance and/or financial incentives to mitigate the fees for such services by third-party energy consultants, such as:
   a. Energy assessment services concerning building envelope components, lighting systems, building controls systems, Heating, Ventilation, and Air Conditioning (HVAC) systems, and maintenance and operations processes, blower-door testing (air leaks), air sealing, ductwork testing, hot water saving measures, and insulation evaluation;
   b. Financial incentives for purchasing and installing energy efficient equipment or financial incentives for repairs/replacement, ie Energy Management System maintenance;
   c. Technical, engineering and implementation retro-commissioning support;
3. Commissioning is the process of MEP system planning, design, documentation, installation, verification and training, to provide a facility that operates as a fully functional system per the Owner's Project Requirements (OPR). Commissioning provides the foundation for correctly benchmarking the baseline energy consumption of the facility, and prepares building staff to

operate and maintain building systems. The Commissioning process begins with the building systems design, and includes oversight and documentation of equipment installation, start-up, control system integration, testing, adjusting and balancing and facility staff training. Buildings that are properly commissioned tend to be more energy efficient and have lower operation and maintenance costs. Systems commissioning is recommended for all projects financed through CHFA that include the installation of new heating, cooling, ventilation or water heating systems.

4. Retro-commissioning is the commissioning process of existing buildings that have not been previously commissioned. It is a process that seeks to improve how building equipment and systems function together. Depending on the age of the building, retro-commissioning can often resolve problems that occurred during design or construction, or address problems that have developed throughout the building's life. In all, retro-commissioning improves a building's operations and maintenance (O&M) procedures to enhance overall building performance. Projects financed through CHFA that are planning moderate and substantial rehabilitations to existing buildings that do not include replacement of HVAC systems, are recommended to include systems retro-commissioning.

5. Benchmarking is the practice of comparing the measured performance to itself, its peers, or established norms, with the goal of informing and motivating performance improvement. When applied to building energy and water use, benchmarking serves to measure energy and water use performance of a building over time, relative to other similar buildings, or to modeled simulations of a reference building built to a specific standard (such as an energy code or higher performance energy efficiency program design and construction standard).

B. Energy Audit Information

Energy Audit is a term for energy studies ranging from a quick walk-through of a facility to identify major problem areas to a comprehensive analysis of the implications of alternative energy efficiency measures. The main issues to be addressed by Energy Audits include:

a. An analysis of existing building and utility data, including study of the installed equipment, and energy bills;
b. A survey of the real operating conditions;
c. An understanding of building behavior and the interactions with weather, occupancy and operating schedules;
d. Selection of and the evaluation of energy conservation measures;
e. An estimation of energy saving potential

Energy Audits should address owner questions regarding the benefits of energy efficiency improvements, such as whether to repair or replace equipment and materials, how much energy use and cost would be reduced (typically 10% - 40%), what the costs to implement the changes would be, whether the proposed initiatives would qualify incentives and/or rebates, and what return on investment (ROI) and property value increase might be realized. The results of the Energy Audit include recommendations for energy efficient upgrades, incentives and regulations, preparation for future incentive programs and progress toward pending mandates or regulations.

Qualified professionals should be retained to perform energy audits. Individuals who perform energy audits have a professional engineer's license in the State of CT, or be a certified auditor/assessor/rater by the Association of Energy Engineers as a Certified Energy Manager (CEM), Building Performance Institute (BPI), Residential Energy Services Network Home

Energy Ratings Systems (RESNET HERS) or ENERGY STAR. Common levels of energy audits are below. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has defined progressive levels of energy audits:

a. Level 1 – Preliminary analysis made to assess building energy efficiency to identify not only simple and low-cost improvements but also a list of energy efficiency measures (EEMs) to orient the future detailed audit. This inspection is based on interviews with site personnel, visual verifications, study of installed equipment and operating data and a detailed analysis of recorded energy consumption. A Level 1 audit is intended to help understand where the building performs relative to its peers, establish a baseline for measuring improvements, decide whether further evaluation is warranted, and if so, where and how to focus that effort. The Level 1 audit also will outline potential financial incentives available from federal, state, local, and utility sources.
b. Level 2 – This type of energy audit consists of an energy use survey in order to provide a comprehensive analysis of the studied installation, a more detailed analysis of the facility, a breakdown of the energy use and a first quantitative evaluation of the EEMs selected to correct the defects or improve the existing installation. This level of analysis can involve advanced on-site measurements and sophisticated computer-based simulation tools to evaluate precisely the selected energy retrofits. Building energy systems are evaluated in detail to define a variety of potential energy-efficiency improvements. This includes the building envelope, lighting, HVAC, Domestic Hot Water (DHW) and plug loads. This study starts with a detailed analysis of energy consumption to quantify base loads, seasonal variation, and effective energy costs, and includes an evaluation of lighting, air quality, temperature, ventilation, humidity, and other conditions that may affect energy performance and occupant comfort. The process also includes discussions with the building ownership, management, and residents to explore potential problem areas, and clarify financial and non-financial goals of the program. The Level 2 audit results in a report to the owner and management team describing a variety of EEMs, including no- and low-cost measures, modifications to system controls and building automation, operational changes, and potential capital upgrades. The findings include general costs and performance metrics, as well as a means for the owner to evaluate the EEMs and decide how to proceed with implementation.
c. Level 3 – This type of “investment-grade” audit provides the Owner a much more thorough and detailed understanding of the benefits, costs, and performance expectations of undertaking the system upgrades or retrofits identified by the Level 2 audit that require significant investments of capital. The ASHRAE Level-3 audit focuses on a whole-building computer simulation, where a computer program is used to very accurately model the way the building would respond to changes in the energy systems, whether those are major HVAC retrofits or architectural modifications to walls, windows, and roof. A Level 3 audit involves much more detailed data, which is used to calibrate a computer model of the facility, so that proposed changes to energy systems can be simulated with very accurate results.

C. Typical Energy Efficiency Project Process

1. Initial Site Assessment and Definition of Goals:
   a. Existing Multifamily Developments: Energy consultants discuss sustainability goals, such as sustainable building design/certification, and potential EE opportunities with owner, multi-disciplinary design and construction team and property managers during

the site assessment stage to result in energy efficiency and sustainability design measures appropriate for the development;

b. Gut Rehabilitation and New Construction Projects: Energy consultants discuss ENERGY STAR, Net Zero Energy, renewables, electrification, resiliency and other sustainable building design/certification program certification goals with the development, design and construction teams during the programming stage. Climate will dictate fundamental characteristics of the site, such as heating and cooling degree days; solar orientation and modes of operational systems. Goals are defined for performance, measurement, verification, ENERGY STAR/other sustainable building design/certification program certification, commissioning, maintenance and operations;

2. Analytics, Benchmarking and Energy Modeling:
   a. Existing Multifamily Developments: Energy consultants perform an energy audit and present recommendations for a scope of sustainability retrofit and improvement measures based on a cost/benefit analysis, including possible utility incentives and rebates for specific measures and/or post-retrofit building performance;
   b. Gut Rehabilitation and New Construction Projects: Energy consultants participate in a process of analysis, recommendation and discussion with the multi-disciplinary design and construction team to design and specify a comprehensive scope of sustainability measures, including possible utility incentives and rebates for specific measures and/or post-construction building performance;

3. Project Finance and Solution Design: Energy consultants coordinate with the development, design and construction teams to identify and compare available options for utility incentives and rebates. Energy consultants continue to participate as a scope of work for competitive bid and pre-certification is refined and utility incentives are finalized;

4. Installation: Energy consultants provide field observation, inspections, measurement and verification for incentives and certifications during construction;

5. Incentives and Certifications Acquisition: Energy consultants compile required test results, reports, checklists and certificates to the utilities for release of incentives and for ENERGY STAR/other Green building design/certification program certifications; and,

6. Post-project: Energy consultants assist the owner and design and construction team with MEP system commissioning, benchmarking with EPA ENERGY STAR Portfolio Manager and submit the necessary documentation for securing energy rebates and ENERGY STAR/other sustainable building design/certification program certification.

II. Energy Conservation Plan: The Development team must submit an Energy Conservation Plan as part of the Consolidated Application, which takes into consideration any testing or energy audits of existing buildings for minor, moderate or substantial rehabilitations, and/or pre-development energy modeling for gut rehabilitation and new construction projects, prepared by a professional engineer and/or BPI-, RESNET HERS- or ENERGY STAR-certified assessors/raters.

A. Rehabilitation Project Definitions: Definitions for Minor, Moderate, Substantial and Gut Rehabilitations are based on the International Existing Building Code, and are found in the CHFA Construction Guidelines: Construction Cost.

B. CHFA Threshold Requirements

1. Minor, Moderate or Substantial Rehabilitations: All proposed energy performance-related equipment, fixtures, controls and appliances should aim to meet or exceed the prescriptive requirements of ENERGY STAR Multifamily New Construction (MFNC) certification program (latest version), or as otherwise indicated in these Standards. ENERGY STAR performance standards for individual equipment, fixtures, controls and appliances can be found on the ENERGY STAR website. The Energy Conservation Plan may include a summary of proposed energy performance-related improvements, and post-construction building performance summary data. The proposed energy performance-related improvements should aim for projected reductions in annual energy use as follows: ≥ 10% for minor rehabilitations, ≥ 15% for moderate rehabilitations and ≥ 20% for substantial rehabilitations.

2. Gut Rehabilitations and New Construction: Proposed gut rehabilitation and new construction projects are recommended to be designed and constructed to meet or exceed the latest ENERGY STAR Multifamily New Construction (MFNC) or ENERGY STAR Single Family New Homes (SFNH) program certification requirements, as allowed by scope and budget.

   In general, single- and two-family homes and townhouses may use SFNH, and all other multifamily buildings must use MFNC. In order to determine which program a project is eligible for, use the "ENERGY STAR Multifamily New Construction Decision Tree on the ENERGY STAR website. Development teams should prepare an Energy Conservation Plan that indicates which ENERGY STAR Program(s) will be used for the project, and whether ENERGY STAR certification may be achieved through the Energy Rating Index (ERI) or ASHRAE 90.1 Paths, and provide a summary of proposed energy performance-related measures. Although ENERGY STAR MFNC offers a Prescriptive Path to certification, since EnergizeCT financial incentives are performance-based, the Prescriptive Path is not ideal. All gut rehab/new construction projects are recommended to be ENERGY STAR-certified.

3. **Energy Conservation Plan –** Threshold data includes the following:

1. Minor, Moderate or Substantial rehabilitations should include the following information:
   a. A summary of all energy conservation-related improvements included in the overall scope of proposed work.
   b. Energy Conservation Data:
      i. Projected Reduction in Annual Energy Use in Percentage;
      ii. Projected Annual Savings in dollars $
      iii. Cost of Energy Performance-related Improvements in Dollars

2. Gut Rehabilitation/New Construction should include the following information:
   a. A summary of all energy performance-related assemblies and equipment included in the overall scope of proposed work.
   b. Details related to projected energy savings, such as:
      i. For dwelling units following the latest ENERGY STAR Multifamily New Construction ERI Path or following the ENERGY STAR Single Family New Homes Path, as applicable: Based on the applicable ENERGY STAR ERI Target Procedure the Projected ERI of each dwelling unit shall be equal to or less than its ENERGY STAR ERI Target. The HERS index is an approved ERI for this determination.

ii. For whole buildings following the ENERGY STAR Multifamily New Construction ASHRAE Path, the Energy Conservation Plan should demonstrate ≥ 15% annual energy cost savings over latest ASHRAE 90.1 Standards requirements.

3. Energy Conservation Plans for all projects must include the following Professional Engineer and/or Certified Assessor/Rater contact information.

D. Quality Control (QC): Soft costs for the ongoing consulting services by the energy professional to review any proposed energy-related scope of work changes and/or adjustments to mechanical systems during construction, and for inspection, blower door and duct blaster air leakage testing, HVAC commissioning and verification of installed components and systems by qualified HERS raters, should be included in the development budget provided with the application. In order to ensure proper operation and maximum HVAC system efficiency under building occupancy conditions, a minimum two-year service contract commencing upon completion of the commissioning of the HVAC system is recommended.

NOTE: All projects are strongly encouraged to pursue the highest levels of energy efficiency and sustainability appropriate and practical for the project given the scope and budget.

Applications committed to certification under Energy Conservation and Green building design programs such as EPA ENERGY STAR, DOE Zero Energy Ready Home (ZERH), Enterprise Green Communities (EGC), National Green Building Standard (NGBS) Certification, Leadership in Energy and Environmental Design (LEED), Passive House Institute United States (PHIUS), and Passive House Institute (PHI) certifications should engage with the organizations administrating those programs or their accredited consultants during schematic design to understand the requirements and processes to ensure post-construction certification. Similarly, applications committed to incorporating measures related to solar and digital connectivity and Broadband should incorporate such measures during schematic design, to understand the requirements and processes that will be required to ensure successful implementation.

2. Application Requirements:
   a. Provide a Letter of Participation and estimate of energy incentives from the utilities.
   b. Minor/Moderate/Substantial Rehabilitation Projects: For moderate to substantial rehabilitation projects replacing HVAC equipment, it is recommended to provide system commissioning and follow-up re-commissioning two years after placed-in-service date. If provided, include necessary soft costs in development budget.
   c. New and Gut-Rehabilitated Projects: It is recommended that new systems be commissioned. Hard and soft costs for system commissioning (if provided) and all sustainable building design/certification program-specific QC requirements shall be identified and included in the Project Cost Summary, Exploded Trade Payment Breakdown and the development budget.
   d. Projects Seeking Federal and/or State Historic Tax Credits: Due to SHPO/NPS restrictions some projects may not be able to qualify for ENERGY STAR due to the restrictions on wall, window and/or roof modifications; however, such projects will be subject to the ENERGY STAR standards and inspections, such that all other measures not affected by the restrictions must verified to be in ENERGY STAR compliance.

3. Initial Closing/42m /ELIHC Requirements: Provide a Letter of Agreement and confirmation of energy incentives from the utility companies; Provide a copy of evidence of energy conservation and Green building design/certification program-specific fee payments, project

registration, pre-certification, checklists of targeted high performance features, and an updated energy model based on the final construction documents after value engineering, as may be applicable; Provide energy conservation and Green building design/certification program-specific Inspection, Measurement and Verification QC Contract and evidence of funds in the development budget soft costs. If the project includes systems commissioning, provide evidence of funds set aside in the development budget for applicable soft costs.

4. Pre-Construction: Energy Consultant and design team should provide a training session to the GC's project manager and site superintendent and a representative of each key sub-contractors to review best practices to build to the sustainable building standards.

5. Construction Phase: Provide Rough-In inspection report (after insulation and before drywall is installed). Evaluate field changes to verify that the project under construction will be able to meet certification/sustainability targets once completed.

6. Closing
   a. Less-than-Gut Rehabilitation Projects: Depending on the level of rehabilitation, the following documentation should be provided with the Cost Certification: Confirmation from the energy professional that the energy conservation measures outlined in the Energy Conservation Plan submitted with the application have been visually verified and, as appropriate, tested and/or graded according to requirements.
   b. New and Gut-rehabilitated Projects: Copies of the ENERGY STAR Certificate confirming certification by the EPA under the latest ENERGY STAR Multifamily New Construction (MFNC) or ENERGY STAR Single Family New Homes (SGNH) program, as applicable. Provide evidence of ENERGY STAR and/or other sustainable building design and certification program certification, as applicable. Energy Consultant and Design team will provide an education/training session for the Property Manager & Maintenance Staff to review best practices to maintain sustainable, high performance buildings and complete the building commissioning process (if included). It is recommended that the Owner/Property manager enter into a minimum two-year HVAC service agreement from the placed-in-service date with the systems installation company, to include follow-up re-commissioning at the end of the contract.
   c. At Lease-up: Property manager/leasing agent will review the use of high performance buildings with all residents. Explain the intent, benefits, use and maintenance of their design features and practices in a Resident Manual to be covered by Property Manager with all new residents. Secure release from residents as part of the lease agreement granting permission to collect energy and water usage information from the utility.
   d. Benchmarking: Upload project energy and water performance data in EPA ENERGY STAR Portfolio Manager, an online utility benchmarking platform annually for at least five years from time of construction completion. Utility allowances may be adjusted based on actual operational performance.
   e. Post-closing: If provided, complete follow-up re-commissioning two years after the placed-in-service date, to ensure building systems and/or equipment are operating according to the performance modeled by the project team in the application. Provide verification, identify and resolve operating issues and performance discrepancies, and ensure the project's ongoing energy efficiency and sustainability.

E. 9% LIHTC Sustainability Design Measures: Preservation Rehabs

Note that Minor, Moderate and Substantial Rehabs, are construction types for the purposes of threshold energy conservation requirements and cost review, which are defined in the CHFA Construction Guidelines: Construction Cost. As relates to the QAP, "Preservation" is defined as the rehabilitation of existing, occupied multifamily rental dwelling units.

LIHTC applications for preservation will require a scope of work, including recommendations from the Energy consultant for the highest energy efficiency and sustainability design measures appropriate for the development. CHFA will expect the proposal to contain the following items to the extent appropriate and practical for the property.

1. Energy Conservation
   - Average projected HERS Index ≤ 70; or
   - ≥ 30% projected reduction in pre-rehab energy use

2. Green Building/Certification Programs
   - Enterprise Green Communities 2020 (EGC 2020) Certification; or
   - National Green Building Standard (NGBS) Certification; or
   - Leadership in Energy and Environmental Design (LEED) Certification.

3. Solar: Provide Solar PV system to the greatest extent possible given the scope and budget - Complete feasibility study and analysis of return on investment in consultation with CT Green Bank. Building-Integrated Renewables: While rooftop solar is a baseline expectation for new construction, there is growth in building-integrated photovoltaics (BIPV)—such as solar glass, solar shingles, and façade-integrated PV. These are especially impactful in dense urban environments where roof space is limited. Innovations in aesthetics and lightweight materials made BIPV a practical and architectural asset.

4. Digital Literacy and Connectivity: Provide infrastructure for High-speed Broadband internet access to units, free High-speed Broadband wireless internet access to community rooms and evidence of engagement with Internet Service Providers (ISPs) to provide subsidized monthly subscription plans for residents. Document any barriers or hardships that may exist.

F. 9% LIHTC Sustainability Design Measures: Gut Rehabs and New Construction

Gut Rehabs and New Construction are construction types for the purposes of threshold energy conservation requirements and cost review, which are defined in the CHFA Construction Guidelines: Construction Cost. As relates to the QAP, "Gut Rehab" and "New Construction" are also defined by the production of new dwelling units in unoccupied buildings of any previous use type, and new buildings.

Benchmarking with the EPA ENERGY STAR Portfolio Manager tool is recommended. Similar to HUD requirements, a Statement of Energy Design Intent (SEDI) and Energy Data Acquisition Plan if available is recommended for new construction and rehab. (NEW)

Balanced ventilation is required as a prerequisite for any of the Energy Conservation measure points. Include a report from the Professional Engineer and/or Certified Assessor/Rater outlining the ventilation requirements, listing specified ventilation equipment and calculations confirming compliance.

1. Energy Conservation

a. Points Criteria:

i. Tier 1 - 2 Possible Points:

- Average projected HERS Index ≤ 46, or
- Average % below the ENERGY STAR Target Index ≥ 25%

ii. Tier 2 - 3 Possible Points:

- Average HERS Index ≤ 42, or
- Average % below the ENERGY STAR Target Index ≥ 35%, or
- Passive House

b. Notes:

i. Renewable energy sources may not be included in the HERS modeling

ii. Balanced ventilation is required as a prerequisite for any of the Energy Conservation measure points.

iii. For projects that are seeking Historic Tax Credits and are subject to SHPO/NPS restrictions, may use projected HERS ratings for which the affected envelope assemblies are modeled according to CHFA Standards.

d. Application Submission and Point Requirements

- Projected average HERS Index ≤ 46 or ≤ 42: Provide drawings, specifications, energy modeling, scope of ECMs and Energy Conservation Plan required to result in the desired average HERS rating, and a report from the Professional Engineer and/or Certified Assessor/Rater confirming compliance.
- Average % below than the ENERGY STAR HERS Target Index ≥ 25% or ≥ 35%: Provide drawings, specifications, energy modeling, scope of ECMs and Energy Conservation Plan required to result in the desired average percentage below the HERS Target rating, and a report from the Professional Engineer and/or Certified Assessor/Rater confirming compliance.
- Passive House: Passive House Institute United States (PHIUS): Provide drawings, specifications, energy modeling, scope of ECMs and Energy Conservation Plan meeting all PHIUS+ building standard and certification criteria. Documentation of compliance by the Certified Passive House Consultant must be provided and all checklists and documentation required for the "Pre-Certification" review submission to PHIUS. All PHIUS Passive House projects must receive third-party verification of all PHIUS+ Passive House requirements provided by PHIUS+ certified raters, who are not part of the design or construction development team.

  Passive House Institute (PHI): Provide drawings, specifications, energy modeling, scope of ECMs and Energy Conservation Plan meeting all PHI building standard and certification criteria. Documentation of compliance by the Certified Passive House Consultant must be provided and all checklists and documentation required for the "Pre-Certification" review submission to PHI. All PHI Passive House projects must receive third-party verification of all Passive House requirements, provided by third-party RESNET HERS- and/or ENERGY STAR-certified assessor/raters who are not part of the design or construction development team.

e. Initial Closing/42m/ELIHC Requirements.

- Projected average HERS Index ≤ 46 or ≤ 42: Provide updated energy modeling, scope of ECMs and Energy Conservation Plan required to result in the desired average

HERS rating, and an updated report from the Professional Engineer and/or Certified Assessor/Rater confirming compliance, based on the final construction documents after Value Engineering, as may be applicable.

- Average % below than the ENERGY STAR HERS Index Target ≥ 25% or ≥ 35%: Provide updated energy modeling, scope of ECMs and Energy Conservation Plan required to result in the desired average percentage below the HERS Target rating, and an updated report from the Professional Engineer and/or Certified Assessor/Rater confirming compliance, based on the final construction documents after Value Engineering, as may be applicable.
- Passive House: Provide evidence of PHIUS + or PHI pre-certification

f. Final Closing/Cost Certification Requirements
- Projected HERS Index ≤ 46 or ≤ 42: ENERGY STAR Certificates for each dwelling unit confirming HERS ratings ≤ 46 or ≤ 42.
- Average % below the ENERGY STAR HERS Target Index ≥ 25% or ≥ 35%: Provide updated energy modeling and scope of as-built ECMs and Energy Conservation Plan confirming the desired average percentage below the HERS Target rating.
- Passive House: Provide confirmation of Passive House certification by PHI or PHIUS

2. **Green Building**

a. Criteria

i. Tier 1 - 2 Possible Points:
- Enterprise Green Communities 2020 (EGC 2020) Certification; or
- National Green Building Standard (NGBS) Gold Certification; or
- Leadership in Energy and Environmental Design (LEED) Gold Certification, or

ii. Tier 2 - 3 Possible Points:
- National Green Building Standard (NGBS) Emerald Certification; or
- Leadership Energy and Environmental Design (LEED) Platinum Certification; or
- Living Building Challenge (LBC) Core Green Building Ready Certification.

b. Application Submission and Point Requirements
- EGC 2020: Provide all required EGC "Pre-Build" submission documentation.
- NGBS: Provide all required "Design Phase" documentation required, including a preliminary scoring sheet showing design eligibility for a Gold or Emerald certification
- LEED: Provide all required documentation to establish a project scope, and a LEED scorecard Gold or Platinum preliminary rating
- LBC: Provide drawings, specifications, energy modeling, scope of ECMs and Energy Conservation Plan meeting all LBC Core Green Building Ready building standard and certification criteria. All documents must be "pre-registration-ready". Provide a report from the Professional Engineer and/or Certified Assessor outlining LBC Core Handbook requirements.

c. Initial Closing/42m/ELIHC Requirements

All projects that were awarded points in the rating and ranking for Sustainable Design must submit proof of project registration and payment of required fees for the specific certification program(s) for which the application was awarded points, and must demonstrate completion of any initial requirements and/or reviews needed prior to start of construction, as conditions for Initial Closing or issuance of a 42m letter.

- EGC 2020: Provide an updated report from the Professional Engineer and/or Certified Assessor/Rater confirming compliance, based on the final construction documents after Value Engineering, as may be applicable. Provide confirmation of "Pre-build Submission" review by Enterprise Green Communities.
- NGBS: Provide an updated report from the Professional Engineer and/or Certified Assessor/Rater confirming compliance, based on the final construction documents after Value Engineering, as may be applicable. Provide confirmation of preliminary scoring spreadsheet review by third-party NGBS Green Verifier.
- LEED: Provide an updated LEED scorecard and report from the Professional Engineer and/or Certified Assessor/Rater confirming compliance, based on the final construction documents after Value Engineering, as may be applicable.
- LBC: Provide review correspondence from the ILFI auditor, updated documentation information from the Professional Engineer and/or Living Future Accredited Professional based on the final construction documents after Value Engineering, as may be applicable.

d. Closing Requirements
   - EGC 2020: Provide confirmation of "Post-build" review and ECG 2020 certification
   - NGBS: Confirmation of NGBS Single Family or Multifamily Gold or Emerald certification by Home Innovation Research Labs
   - LEED: Confirmation of LEED Residential Single Family or LEED Residential Multifamily Gold or Platinum certification by the U.S. Green Building Council
   - ILFI Core Green Building Standard Ready: Provide confirmation of ILFI 3rd-party audit review and LBC Core Green Building Ready designation by ILFI

3. **Solar PV System – 2 points**

a. Criteria - Solar PV system designed to offset the annual energy demand to the greatest extent possible given the project scope and budget.

b. Application Submission and Point Requirements: Provide a summary letter or report from a Professional Engineer and/or qualified solar system designer describing the estimated annual energy demand and verifying the qualifying capacity of the proposed system being the most robust possible given the scope and budget.

c. Initial Closing/ELIHC/42m Requirements: Solar PV system designed to offset annual energy demand. Provide an updated summary letter or report from a Professional Engineer and/or qualified solar system designer describing the estimated annual energy demand and verifying the qualifying capacity of the proposed system, based on the final construction documents after Value Engineering, as may be applicable.

d. Closing Requirements: Solar PV system designed to offset annual energy demand. Provide an updated summary letter or report from a Professional Engineer and/or qualified solar system designer describing the estimated annual energy demand and verifying the qualifying capacity of the proposed system, based on the as-built project.

5. Operations and Resiliency:

a. **Digital Literacy and Connectivity:** High-speed Broadband Access to Units - 1 Possible Point

b. **Commissioning:** Commissioning of building systems, equipment and controls - 1 Possible Point

c. Application Submission and Point Requirements: Provide a detailed plan for providing the infrastructure for high-speed broadband internet access to apartment units, and free high-speed broadband wireless internet access to Community Rooms, as defined by the FCC (minimum download speed 25 Mbps; minimum upload speed 3 Mbps), via a cable, wireless, fiber optic or satellite network.

   Provide system cost, evidence of funds set aside in the development budget for installation, evidence of the projected cost for installing a broadband internet access system in the Project Cost Summary and Exploded Trade Payment Breakdown, and evidence of the projected cost for providing on-going subsidized broadband internet access in the development budget. Provide evidence of engagement with Internet Service Providers (ISPs) to provide subsidized monthly subscription plans for residents, and document any barriers or hardships that may exist. The subsidized broadband internet service to residential units and the free internet to the community room should be available for the full compliance period. The subsidy can be from a pre-funded reserve in the development budget. Evidence of how the amount was calculated will be required.

   Commissioning of building systems, equipment and controls: If included, provide a proposed Commissioning contract for MEP system planning, design, documentation, installation, verification and training, to provide a facility that operates as a fully functional system per the Owner's Project Requirements (OPR), and evidence of the projected cost for Commissioning in the development budget.

b. Initial Closing Requirements: Provide an updated broadband internet access plan and installation cost, based on the final construction documents after Value Engineering, as may be applicable. Commissioning of building systems, equipment and controls: If included, provide a copy of a signed, minimum two-year commissioning/re-commissioning contract with the plan for MEP system documentation, installation, verification, pre-turnover staff training, and post-occupancy measurement and verification, and evidence of the contract cost in the development budget.

c. Closing Requirements: Provide a letter from the broadband system installer/internet service/managed wi-fi provider confirming that, based upon on-site testing, the system provided meets the minimum-required download and uploads speeds. Commissioning of building systems, equipment and controls: If included, provide a copy of the post-construction/pre-occupancy commissioning report, two-year service contract and follow-up re-commissioning report.

ENERGY CONSERVATION & SUSTAINABILITY CONSTRUCTION STANDARDS

Waste Management & Disposal: Dispose of construction debris only at a Connecticut or other state-approved construction and demolition landfill. No construction materials shall be burned or buried on-site.

1. Construction Waste Management Plan: The GC should post a construction waste management plan on the job site, and each subcontractor should be educated on the aspects of the plan that pertains

to their work. Waste management plan may provide for on-site grinding and re-use, or separation of materials to be recycled by clean-up or waste-hauling firms. Consult your local jurisdiction for allowable materials and appropriate practices.

2. Recycling: Construction waste includes plastics, wood, cardboard and paper, drywall and ceiling panels, metals, shingles, fluorescent bulbs, concrete and dirt - materials that may be reused or recycled if properly prepared. Identify the types and quantities of materials generated at the job site, and contact local recycling facilities and haulers to determine terms and conditions required for recycling them. Allocate space for recycling materials.

Low Impact Development: Low Impact Development (LID) for sustainable storm water management, to re-use storm water as a viable resource, to control storm water and conserve rainwater, is encouraged.

1. LID site design strategies address the arrangement of buildings, roads, parking areas, site features, and storm water management holistically, to retain, detain, store, change the timing of, or filter runoff in a number of different configurations and combinations.

2. LID Technologies and Water Conservation: Depending on which level of on-site reuse and water conservation is consistent with project objectives, various LID technologies are suggested:
   a. Level One – Distribution: Storm water runoff is distributed using open and vegetated areas to increase infiltration and reduce the amount of storm water that enters the storm drains, through sheet flow to rain gardens, bio-swales, bio-retention cells, tree box filters, soil amendments, structural soil, native and sustainable ornamental plants;
   b. Level Two – Hardscape Materials and Curbs: Replace hardscape materials with permeable materials curb-less parking lot islands, porous concrete parking bays, and Level One technologies; and,
   c. Level Three – Recycling Rainwater and Runoff: This level uses above-ground LID devices – disconnected roof drains, cisterns, sub-surface storm water retention facility (below parking lots), rooftop channels, rain barrels – to channel and collect rainwater from roofs, and uses sub-surface facilities to treat and collect runoff from roads and sidewalks, in conjunction with Level One and Level Two technologies. The recycled and stored water is used for irrigation and other non-potable purposes. The devices are integral with the buildings and infrastructure.

Irrigation: Every effort shall be made in the design and plant specification for landscapes to prevent or minimize the need for irrigation. Low-water landscape designs, such as xeriscaping, are encouraged. Select slow-growing, adaptable and drought-tolerant plants which withstand rainfall shortages and utilize less water for irrigation. Soil shall be tested and amended to improve the growth of plants and grasses.

Where irrigation is provided, utilize techniques and systems designed to conserve water, including water-smart landscaping, drip and micro irrigation, high-efficiency dishwashers, faucets, and showerheads and clothes washing machines, alternative water sources, including on-site rainwater collection/retention, graywater collection/retention.

A. Irrigation Design, Controls and Smart Water Application Technologies (SWAT): If irrigation must be provided, the system shall be designed by an EPA WaterSense®-certified professional. Appropriate equipment and design principles shall be practiced regarding terrain, planting materials, exposure and obstructions. As much as practical, provide separate zones for sun and shade, and limit daily total run-

times and over-spray onto walks, public roads, parking areas, and buildings. Where it is not practical to separately zone full and part circle rotaries, use matched precipitation rate sprinklers, or increase the nozzle size of the full circle sprinklers to more nearly match the precipitation rate of the part circle sprinklers. Booster pumps shall be approved by the local municipality.

1. Irrigation controls shall not be located within residential units. Control timers located outdoors are to be in a weather-resistant locking metal enclosure; "hybrid"-type mechanical controllers with solid-state circuitry are preferred.

2. “Smart”, climate-based irrigation controllers, as recommended by the Irrigation Association SWAT initiative and the EPA WaterSense® Program, are encouraged in lieu of traditional “timer” controls. Program controllers to apply the right amount of water to maintain healthy growing conditions for specific plant materials, based on real-time weather data, soil types, slope, root zone storage, plant types, irrigation types, irrigation efficiency, precipitation rate, moisture, rain, and wind, etc.

CONCRETE

A. Backfill: The use of recycled concrete rubble for backfill and drainage at the base of foundations is encouraged as a way to reduce global warming potential (GWP).

B. Concrete with Fly Ash or Slag and Recycled Concrete Used as Aggregate: As a way to reduce GWP, the use of fly ash and slag as inexpensive substitutes for 15% - 40% of the Portland cement used in concrete for footing, foundation walls, and slabs is encouraged. Demolished concrete may be used as an aggregate in poured concrete structures.

C. Air Conditioner Condensing Unit Pads: The outdoor pads for air conditioner or heat pump condensing units shall have a minimum of 50% recycled material content (such as plastic or rubber tires), as verified by the manufacturer.

UNIT MASONRY: Sustainable Masonry Practices: The use of on-site, indigenous Connecticut and New England earth materials, such as common clay, dimensional stone (granite, quartzite and sandstone), crushed stone, construction sand and gravel, and lime, and locally/regionally-produced brick and concrete masonry units, is encouraged.

Rough Carpentry: **Engineered Wood Products**: The use of engineered wood for headers, joists, and sheathing is encouraged. Large size lumber can be replaced with engineered lumber, such as microlams, paralams, and glulams. All materials, methods and details shall comply with Engineered Wood Construction Guidelines by the American Plywood Association (APA). Where structural loads allow, single-piece 1¾" structural engineered wood headers provide room in the wall cavity for insulation (provide full-depth horizontal blocking at window head). Solid wood framing lumber shall be Western Wood Products Association (WWPA) grade-stamped and stress-graded. Framing lumber shall be graded “S-dry,” max MC=19% and free of warping, checking or other defects. Load-bearing stud framing shall be #2 grade or better. Finger-jointed studs (graded equivalent to full dimensional studs - 1997 UBC Standard, Chapters 23 and 35) may be used. Spanning members shall be graded F_b=1400; E=1.4. Framing lumber abutting concrete or masonry shall be WWPA grade stamped pressure-treated unless

otherwise required. All lumber at exposed exterior locations or which abuts concrete or foundations, such as sill plates, shall be pressure-treated. Solid white spruce framing lumber shall not be used.

1. Whenever possible, use reclaimed lumber for nonstructural applications, in place of new material.

2. As a way to reduce GWP, the use of recycled content materials for decking, and outdoor amenities such as picnic tables, mail kiosks, gazebos, and playgrounds is encouraged. Recycled plastic lumber contains only recycled plastic resins, while composite lumber is made by combining recycled wood fiber and recycled plastic resins that are then formed into deck boards. Both products may be used in place of old-growth redwood, cedar and pressure-treated pine. Follow manufacturer recommendations closely regarding the amount of expansion that will occur when using recycled-content plastic lumber.

3. The use of sustainably-harvested Forest Stewardship Council (FSC) Certified Wood for new framing materials is encouraged.

4. Where wood “stick” framing is provided, utilize resource-efficient Advanced Framing Techniques (AFT) to minimize material usage, while meeting model code requirements:
   a. Evaluate the use of 24" modular dimensions, rather than standard 16" modules at exterior wall framing.
   b. Utilize 2 x 6 exterior wall studs rather than standard 2 x 4 studs.
   c. Evaluate the use of 19.2" or 24" o.c. modular dimensions, rather than the standard 16" o.c. at floor and roof framing. To compensate for the increased panel span, provide floor and roof sheathing that is ⅛" (min.) thicker than may otherwise be required.
   d. Use floor and roof trusses, rather than stick framing.
   e. Use “in-line” or “stack” framing to transfer loads directly to the foundation and minimize headers
   f. Use 2-stud “California” corner framing with furring or drywall clips or equivalent alternative framing technique, rather than 3-stud corners.
   g. Use horizontal ladder framing, full-length furring, drywall clips or equivalent alternative framing technique at wall “T” intersections, rather than 3-stud corners.
   h. Up-set exterior wall headers into floor framing above to allow for full insulation immediately above windows and doors.
   i. Eliminate interior wall headers in non-bearing walls, and engineer headers in bearing walls to adequately support loads with the smallest members possible.
   j. Where provided, double walls should be two, independently-framed walls, with all framing off-set (except at window and door openings), to minimize thermal bridging and allow for continuous insulation.

5. To ensure installation of the full depth of required attic insulation above exterior wall top plates, without being compressed by insulation baffles, provide energy heel trusses with raised top chords, or raised top plates for joist/rafter assemblies.

6. Wood products containing urea formaldehyde (UF) resin binders shall be avoided. Consider products manufactured with adhesives which decrease or eliminate formaldehyde content and emissions, such as phenol formaldehyde (PF), phenol urea formaldehyde, melamine urea formaldehyde, methyl di-isocyanate (MDI), hybrid UF/MDI and PF/MDI, and natural tannin and soy-protein resins. All

composite wood products must be labeled for compliance with California Air Resources Board (CARB) No Added Formaldehyde (NAF), No Added Urea Formaldehyde (NAUF) and Ultra-Low Emitting Formaldehyde (ULEF) Airborne Toxic Control Measure (ATCM) emission standards.

7. The use of treated wood that does not contain chromium or arsenic for decking and sill plates, and outdoor amenities such as picnic tables, mail kiosks, gazebos, and playgrounds is encouraged. All materials, methods and details shall comply with American Wood-Preservers' Association (AWPA) standards.

8. Where possible, use solvent-free products in place of standard adhesives for all interior applications such as installation of flooring, countertops, wall coverings, paneling, and tub/shower enclosures. Laminating adhesives, and all other construction adhesives used indoors shall have maximum Volatile Organic Compound (VOC) contents in compliance with EPA 40 CFR 59. Such adhesives may include, but not necessarily be limited to:
   a. Multipurpose construction adhesives, subfloor adhesives, drywall and panel adhesives, vinyl composition tile (VCT) and asphalt tile adhesives, cove base adhesives, carpet pad adhesives and indoor carpet adhesives;
   b. Rubber floor adhesives;
   c. Ceramic tile adhesives;
   d. Structural glazing adhesives;
   e. Wood flooring adhesives;
   f. Outdoor carpet adhesives; and,
   g. Single-ply roof membrane adhesives.

THERMAL & MOISTURE PROTECTION: Energy-Efficient Building Envelope:

Comprehensive measures to reduce energy consumption due to air leakage, avoid moisture condensation problems and uncomfortable drafts, and provide high indoor air quality through reduced indoor air pollution shall be employed in the design and construction of all rehabilitated and new multifamily residential facilities financed through CHFA. At a minimum, building envelope insulation and air infiltration, windows, doors, heating, cooling and water heating equipment, thermostats, ductwork, lighting, appliances and plumbing fixtures must meet or exceed the minimum requirements of the prevailing version of the CT State Building Code, and the EPA ENERGY STAR New Construction Program Requirements for the Connecticut County where the site is located. However, note that the minimum Code/ENERGY STAR requirements may not meet the performance-based CHFA Standards, specific funding program incentives and/or utility-administrated rebate program requirements.

A. Air Infiltration: Provide air barriers and other air sealing measures as required for creating a continuous airtight exterior building envelope. The current IECC code defines and lists approved air barrier products, which may include self-adhered membranes, fluid-applied membranes, closed-cell spray polyurethane foam, open cell spray polyurethane foam, or board-stock. When specified, spray foam must be Greenguard-rated. Some air barriers may be water vapor permeable, while others may also function as vapor barriers. Avoid creating double vapor barriers that prevent drying of building assemblies. Provide all air barrier accessories required to connect and maintain air tightness between air barrier materials, assemblies and components, and to fasten them to the structure of the building; i.e., sealants, tapes, backer rods, transition membranes, nails/washers, ties, clips, staples, strapping and primers. Inspect materials and accessories as they are installed, to verify that the air barrier has no punctures and is completely sealed. .

a. All dwelling units in multifamily buildings shall be compartmentalized, to reduce the transfer of water vapor, air, smoke, odors, pests and noise from adjacent dwelling units and common spaces.
   i. Provide air barriers and other air sealing measures at common walls, floors and ceilings between dwelling units, and between dwelling units and common spaces;
   ii. Seal all plumbing chases, exhaust ventilation and heating system components, electrical outlets and controls, window and exterior door rough openings, and intersections between interior, party and demising partitions with exterior walls, etc.; and,
   iii. Dwelling unit air infiltration rates shall be less than or equal to the minimum requirements of the prevailing version of the CT State Building Code, and the EPA ENERGY STAR New Construction Program Requirements for the Connecticut County where the site is located..

B. Air Sealing Measures: Provide air sealing measures that meet or exceed the minimum requirements of the prevailing version of the CT State Building Code, and the EPA ENERGY STAR New Construction Program Requirements for the Connecticut County where the site is located. Architectural plans must clearly show the building and dwelling unit air barrier materials and locations, and details shall be provided for sealing all air barrier connections and penetrations. Typical air sealing measures may include, but not necessarily be limited to, the following:

1. If basement or below-grade spaces are designed and constructed to be occupied, basement walls should be perimeter-insulated with vapor-impermeable rigid insulation panels with taped, sealed joints or with closed cell foam to prevent interior air from contacting cold masonry walls. No interior vapor barriers should be installed in basements. Provide sealant at joints between wood wall and first floor rim framing members, perimeter rigid insulation panels and interior finish panels.

2. Framed spaces that connect conditioned areas to unconditioned attics, basements or crawl spaces shall be sealed on both sides with a sealed air barrier. These areas include chases for plumbing, duct work, chimneys and flues. If soffits are to be installed adjacent to unconditioned spaces e.g. unconditioned attics, a sealed air barrier shall be installed to the unconditioned space interface before the soffits are framed. For chases with high temperature heat sources, noncombustible sheet materials, such as sheet metal and high temperature caulk, shall be used. Where the code prohibits sealing this gap (such as with fireplace flues) manufacturer-supplied sheet metal shall be used that fits the flue pipe as closely as allowed. Breaks in framing and interior finish materials that connect unconditioned and conditioned areas, such as for dropped soffits and changing ceiling heights, shall be sealed with blocking or sheet material and sealant.

3. All holes in the floor assembly for plumbing, wiring, ductwork, and other purposes connecting conditioned and unconditioned (and exterior) areas shall be sealed. Penetrations for flues and other heat-producing items shall be sealed with noncombustible sheet materials and high temperature sealant.

4. Air-impermeable blocking shall be installed between floor joists underneath kneewalls to seal the floor joist cavities. Align the outside face of the blocking with the inside face of the kneewall framing, to allow cavity insulation to extend under the kneewall. Seal seams at any location where attic air may enter the band area between conditioned floors.

5. Bottom plates shall be sealed to foundations and floors with a foam gasket to provide a moisture barrier beneath the bottom plate and a suitable sealant. Apply sealant between the interior of wall plates and gypsum board wall panels and between the exterior of wall plates and exterior wall

sheathing.

6. The shim space between the framing for window or door (including attic access) rough openings and the installed units shall be sealed with low-expansion spray foam sealant, closed-cell foam backer rod, spray applied insulation, or other suitable sealant. Cellulose, fiberglass or rock wool batt insulation is not acceptable as a sealant but can be used as a backing for a sealant (such as caulk). Thresholds for exterior doors shall be sealed to the subfloor.

7. All gaps in exterior sheathing, such as seams between adjacent sheets, shall be sealed with a proper sealant. All penetrations, such as holes drilled for condensation lines and utility boxes, shall be sealed with an airtight boot, caulk, spray foam or equivalent. Tape all joints in foam sheathing. Extend sheathing below bottom plate and seal.

8. All holes drilled for piping, conduit, wiring and other penetrations through the rim joists, must be sealed.

9. All duct, electrical, plumbing and other penetrations through insulated floor systems (such as basements, crawlspaces, and garages) over unconditioned areas must be sealed.

10. All penetrations through insulated ceilings, including HVAC duct boots, bathroom fans, light fixtures, sprinkler heads, security, and audio speakers must be sealed.

11. Recessed can or high hat lights in ceilings with unconditioned areas above, must meet the latest energy code specification or air tightness, and must be Insulation Contact-rated.

12. Floors with conditioned area over unconditioned open areas shall have the floor joist cavity sealed with air-impermeable insulation blocking and sealant above the top plate of the bearing wall.

13. Doors in kneewalls and attic scuttle holes that connect conditioned space to unconditioned attic areas shall be weather-stripped and latched to provide an airtight seal against the door trim and wall drywall.

14. All seams in band joists between conditioned floors shall be sealed.

15. Plumbing penetrations shall be blocked with air-impermeable insulation and sealed at edges with proper sealant. Rockwool, or similar products, shall not be used. An interior air barrier shall be installed behind tub and shower units on insulated walls before installing bath and shower assemblies. The air barrier material must be sealed with a proper sealant and the exterior wall must be insulated to the requirements of the energy code.

16. All penetrations of drywall in insulated walls, including wall switches, electrical outlets and kneewall door rough openings shall be sealed.

17. Drywall shall be sealed to the top plate of all walls at ceilings separating attic from conditioned space. Gaskets, caulk or foam can be used to air seal the top of the walls at any stage of the installation.

C. Sealants and Caulking: Furnish and install sealants to provide a complete and finished installation of building systems, components, fixtures, fittings and accessories, and to protect building systems, components, fixtures, fittings and accessories from water and/or air penetration. Caulk all exterior joints between dissimilar materials, around the exterior frames of all windows and doors, and all control joints.

Organic-type caulking is not acceptable. Take care to provide a smooth, consistent, and clean application of sealant in all areas where the sealant bead is exposed. Consult the sealant manufacturer prior to installation to verify the proper type and chemical composition of sealant for each type of application.

1. The contractor shall furnish and install backer rods in all expansion joints, or any joint where movement is to be expected, prior to installation of sealant to ensure the correct hour glass profile of the sealant, and to provide a suitable stop for the sealant in deep joints.

2. All interior and exterior sealants shall have maximum Volatile Organic Compound (VOC) contents in compliance with EPA 40 CFR 59. Provide a 5-year manufacturer's standard material warranty, including replacement of sealant materials which fail to adhere, cure or provide a water-tight seal.

Insulation: A thermally-protected building envelope shall be provided, with ceiling, above-grade wall, floor, basement wall and under-slab insulation materials that meet or exceed the minimum requirements of the prevailing version of the CT State Building Code, and the EPA ENERGY STAR New Construction Program Requirements for the Connecticut County where the site is located. Provide roof/attic floor details that allow for the full depth of attic ceiling insulation to extend over the exterior wall plate. Where roof framing is insulated, full-width baffles shall be placed between framing members in all framing bays to allow for cold air movement across the bottom of the roof sheathing and to prevent insulation from migrating into the vented soffit area. For all new and gut rehab projects, and any less-than-gut rehab projects that will be retrofitted with additional insulation, the building envelope must be evaluated by a professional engineer, and/or RESNET HERS, BPI or ENERGY STAR certified assessor/rater, to ensure that the specified building assemblies will allow for adequate drying to the inside and/or outside and do not create conditions for entrapment of moisture, which might lead to a reduction in energy performance, deterioration of materials and formation of molds.

A. Insulation Installation Requirements: Installation of all insulation shall be performed with the utmost care, with the highest standard of professional workmanship, in strict compliance with manufacturer's specifications and insulation instructions, and RESNET HERS "Grade I" standards. Third-party verification by a RESNET HERS accredited RESNET HERS Rater as "Grade I" insulation is required for ENERGY STAR compliance and to qualify for utility-administered energy incentives.

B. Continuous Insulation: Where continuous insulation is required over framed areas with fully-insulated cavities, provide rigid insulation panels, such as expanded polystyrene, extruded polystrene, polyisocyanurate, or mineral wool as required. Follow manufacturer's recommended means and methods of installation, including proper adhesives, fasteners and joint-sealing tape.

C. Insulated Sheathing Panels: Where exterior finishes are to be installed over continuous insulation, consider composite insulating sheathing panels consisting of 4' x 8' closed cell polyiscyanurate foam bonded to fiber-reinforced facers on one side, and ½" or ⅝" CDX plywood or OSB sheathing on the other, or panels consisting of 4' x 8' closed cell polyiscyanurate foam bonded to fiber-reinforced facers on one side, a middle layer of 1", 1½" or 2" solid wood ventilation spacers, and a top layer of ½" or ⅝" CDX plywood or OSB sheathing. Follow panel manufacturer's recommended means and methods of installation, including proper adhesives, fasteners and joint-sealing tape.

D. Plumbing: Pipes that carry water, such as hot and cold supply pipes, steam lines, hydronic heat pipes and air conditioner condensate lines shall not be installed in exterior walls. If plumbing in the exterior

wall cannot be avoided, a separate plumbing chase wall shall be provided inside the insulated exterior wall.

E. Interior Walls with Plumbing Intersecting Exterior Walls: Where unit separation walls or other interior walls with plumbing intersect exterior walls, insulation shall be placed in the first framing bay of the framed interior wall to minimize the chance for frozen pipes in other framing bays.

F. Insulated Headers: Provide R-10 (min.) insulated headers. Consider pre-fabricated insulated headers, with engineered lumber framing and rigid-foam cores.

G. Energy Heel Trusses/Raised Top Plates: Extend full depth of the attic insulation over exterior wall top plates at energy heel trusses with raised top chords, and raised top plates at joist/rafter assemblies.

H. Attic Ventilation: Eave soffit and continuous ridge ventilation and/or through-wall gable-end vents shall be provided in sizes required to vent attic spaces. Install equal capacities of clear ventilation in the soffits/eaves and the gable ends/ridges. Provide 1 ft² of net free area of venting for every 300 ft² of attic floor (min.). Keep insulation from blocking the soffit vents.

I. Attic Access Doors: Weather-strip and adhere rigid insulation onto the back of attic access doors and scuttle covers equivalent to, or exceeding the insulation level in the surrounding attic floor area as required by the prevailing version of the CT State Building Code, and the EPA ENERGY STAR New Construction Program Requirements for the Connecticut County where the site is located.

J. Foundation Walls: Provide vapor-impermeable rigid foam insulation with taped joints.

K. Bond-break at Contiguous Slab Locations: Concrete slabs in unconditioned areas (e.g. garages, porches,) that are in contact, or may come into contact, with slabs in conditioned areas due to settlement, shall be thermally separated with R-10 (min.) insulation covering the surface of potential slab contact.

L. Insulated Corners: Extend required exterior wall insulation into the outside corner of two insulated walls framed with two-stud “California” corner framing with furring or drywall clips, or equivalent alternative framing technique.

M. Insulated T-Walls: Provide continuous insulation at the intersections of an interior and insulated exterior walls framed with horizontal ladder framing, full-length furring, drywall clips or equivalent alternative framing technique.

N. Alternative Insulation Products: Consider the use of alternative insulation products as a way to reduce GWP, such as recycled content, formaldehyde-free fiberglass, dry-blown, loose-fill or spray cellulose, spray-on/pour-fill cellular plastic insulation and/or a hybrid Insulation and air-sealing system (fast-setting, low-expanding two-part foam framing envelope sealant and fiberglass batt insulation infill).

Roofing

A. “Cool” Roofing: Roof coverings shall consider the specifications for ENERGY STAR Qualified cool roof products.

1. Roof products that are typically installed on low-slope surfaces (2:12 pitch or less) include single-ply membranes, built-up-roofs, modified bitumen, spray polyurethane foam, roof coatings, and. Some

products that are typically installed on low-slope roofs may also be installed on steep-slope roofs (e.g., single-ply membranes and roof coatings).

2. Roof products that are typically installed on steep-slope surfaces (greater than 2:12 pitch) include composite shingles, clay, concrete, or fiber-cement tile, slate, shakes, architectural profiled metal, standing-seam profiled metal and individual metal roof components.

3. To avoid condensation under light-colored, reflective membrane roofing, insulate fastener heads from the building exterior and eliminate air flow through the system. Mechanically-fasten the first layer of insulation over a vapor barrier into the decking, adhere the second layer of insulation to the first layer of insulation, and then adhere the roof membrane to the top layer of insulation.

4. Consider providing light-colored metal roofing for long-term reduced maintenance and increased useful life. For re-roofing projects, metal roofing may be able to be applied over the original roof, saving removal and disposal costs.

Siding: **Recycled-content Siding**: Consider the use of siding with a recycled content as a way to reduce GWP. Recycled-content siding includes varying amounts of recycled materials, and may be used wherever wood siding would be desirable. Recycled-content siding options include fiber cement, flat-rolled aluminum and steel, poly-ash and engineered wood.

WINDOWS, SKYLIGHTS & DOORS

A. Energy and Performance Requirements: All window and skylight areas must comply the minimum thermal resistance values in accordance with the prevailing version of the CT State Building Code, and the EPA ENERGY STAR New Construction Program Requirements for the Connecticut County where the site is located. Windows, skylights, and glass doors shall be manufactured in accordance with National Wood Window and Door Association (NWWDA), American Architectural Manufacturers Association (AAMA), Window and Door Manufacturers Association (WDMA) and Canadian Standards Association (CSA) standards, rated by the National Fenestration Rating Council (NFRC), and labeled accordingly. All windows shall have been tested for compliance with AAMA/WDMA/CSA standards, within the past four years, and shall have met or exceeded the following performance standards: minimum performance grade LC-PG40; minimum design pressure 40 psf; minimum structural test pressure 60.5 psf; minimum water penetration test pressure 6 psf; positive test pressure 75 Pa (1.6 psf); and maximum allowable leakage 0.30 cfm/sf.

B. Extra-high-performance Glazing: Consider optimizing window performance by providing extra-high-performance glass. Triple glazing with double interior interspaces containing argon/krypton gas, can provide superior insulating values (U values $\leq$ .20 and R-values $\geq$ 5), UV blockage, sound control, condensation resistance, and radiant comfort. Glazing options and shading structures can be directionally "tuned" for natural lighting and solar energy conditions on northern, eastern, southern and western building orientations, to provide passive solar heating benefits in the winter, and moderate mid-day and afternoon overheating in the summer.

Doors: **Exterior Door Energy Performance Requirements**: All opaque, ≤ ½ lite and ≥ ½ lite doors must comply the minimum thermal-resistance values in accordance with the minimum requirements of the

prevailing version of the CT State Building Code, and the EPA ENERGY STAR New Construction Program Requirements for the Connecticut County where the site is located.

Gypsum Board and Acoustic Ceiling Panels: **Acoustic Ceiling Panels**: As a way to reduce GWP and improve indoor air quality, consider using acoustic ceiling panels with recycled content, low or zero formaldehyde emissions, anti-microbial treatments and high light reflectance values for resource conservation and light quality.

Floor Finishes

A. Resilient Flooring: Consider providing resilient flooring tile made from limestone and ethylene acrylic polymers as a PVC-free alternative to VCT.

B. Rapidly-Renewable Flooring Materials: Consider using bamboo and cork flooring as alternatives to hardwood flooring and carpeting. Provide products made without the use of UF binders, such as bamboo flooring and panel products made with polyisocyanurate or phenol formaldehyde binders.

Paints and Coatings

A. Non-toxic Paint Strippers: In lieu of paint strippers with methylene chloride as the active ingredient, consider using water-soluble, non-caustic and non-toxic paint strippers with the organic solvent N-Methylpyrrolidone.

B. Low-VOC and Formaldehyde-free Paint and Water-based Wood Finishes: Specify low-VOC, formaldehyde-free paints. Where wood finishes are required, consider using low-VOC, water-based wood finishes with maximum Volatile Organic Compound (VOC) contents in compliance with EPA 40 CFR 59.

C. Low-VOC Paint and Architectural Coating Standards: "Low- VOC" (Clean Air) paints, which meet the regulatory limits in the South Coast Air Quality Management District (AQMD) Rule 1113, are manufactured and sold by numerous companies; however many manufacturers have reformulated to levels well below these limits. Those that meet a VOC standard of <10 g/L are referred to as super-compliant by the AQMD, which maintains a list of manufacturers of super-compliant products on their website.

1. Paints and other architectural coatings have maximum Volatile Organic Compound (VOC) contents in compliance with EPA 40 CFR 59:
   a. Driveway sealer, flat coatings, floor coatings, non-flat coatings, sacrificial anti-graffiti coatings, and roof coatings;
   b. Non-sacrificial anti-graffiti coatings, primers, sealers and under-coaters, roof coatings (aluminum,) rust preventive coatings, specialty primers, stains, traffic coatings, waterproof sealers and waterproofing (concrete)/masonry sealers;
   c. Low-solids coatings;
   d. Concrete surface retarder, form release compound and stains (Interior);
   e. Clear wood finishes;
   f. Mastic coatings;
   g. Bond breakers, reactive penetrating sealers, roof primers (bituminous) and wood preservatives;
   h. Pre-treatment wash primers;

i. Metallic pigmented coatings;
j. Shellac (pigmented); and,
k. Shellac (clear).

D. Natural Paints and Finishes: Consider using paints and finishes made from natural raw ingredients such as water, plant oils and resins, plant dyes and essential oils; natural minerals such as clay, chalk and talcum; milk casein, natural latex, bees' wax, earth and mineral dyes**.**

E. PVC-free Peel and Stick Wall Covering: Where wall coverings are desired, consider using PVC-free self-adhered textile wall covering containing 100% recycled polyester wall coverings in lieu of standard vinyl wall coverings as a way to reduce GWP.

EQUIPMENT

A. Residential Appliances: All refrigerators, dishwashers, clothes washers, clothes dryers and ceiling fans must be ENERGY STAR-qualified. Choosing the most energy-efficient ENERGY STAR-qualified appliances may qualify for utility-administered incentives.

Plumbing: All bathroom faucets, aerators and shower heads should comply with the EPA WaterSense® Program standards.

Water Heaters: All water heating equipment must meet or exceed the minimum requirements of the prevailing version of the CT State Building Code, and the EPA ENERGY STAR New Construction Program Requirements for the Connecticut County where the site is located.

A. Residential Water Heater Efficiency Requirements: High-performance, all-electric buildings are strongly encouraged. When provided, residential gas water heaters must be ENERGY STAR-qualified.

B. Tankless Water Heater Efficiency Requirements: High-performance, all-electric buildings are strongly encouraged. Consider using ENERGY STAR-qualified tankless natural gas or propane domestic hot water heaters (DHW) to conserve heating time and energy use. Install "right-sized" tankless water heaters with variable-set thermostats as close to the point of use as possible. Specifying the most energy-efficient ENERGY STAR-qualified equipment may qualify for CEEF incentives.

C. Commercial Water Heaters: Where required, commercial, central water heaters must be ENERGY STAR-qualified. All common water heating distribution systems shall adaptive or demand-activated recirculation systems.

Heating, Ventilation, and Air Conditioning (HVAC): All heating and cooling equipment must meet or exceed the minimum requirements of the current CT State Building Code, and the EPA ENERGY STAR New Construction Program Requirements for the Connecticut County where the site is located.

A. Furnaces, Boilers and Heat Pumps

1. Furnaces: Choosing the most energy-efficient ENERGY STAR-qualified equipment may qualify for CEEF incentives. Furnaces shall have variable-speed blowers and programmable thermostats. Each zone shall have a separate temperature control and wired damper controls. Wherever possible,

air handlers shall be located within conditioned spaces. Furnace filters shall not be made of fiberglass. All furnaces shall bear all applicable UL-listed and AGA-certified labels.

2. Modular Boilers**:** Where provided, boiler systems shall have two or more boilers, and shall be furnished with a control panel designed to reset the supply water temperature based on the outdoor temperature. The control panel shall step-fire the boilers in sequential order. Boiler drains from pressure-temperature relief valves shall not be discharged onto the floor. A separate protective pan, connected to a floor drain shall be installed under all boilers.

B. Ventilation: Tight, high-performance building envelopes are strongly encouraged or required by CHFA Energy Conservation & Sustainability Guidelines. Such buildings must rely on mechanical systems to meet ventilation requirements, and the project team needs to ensure that:

- Any equipment parts/filter (for example-filters for ERVs) that need to be maintained shall be easily accessible in lockable mechanical closets or access doors.
- ERV systems should be hard-wired to run continuously in order to avoid condensation and provide the best indoor air quality.
- The management company shall be responsible for equipment maintenance and filter cleaning/replacement in accordance with the equipment manufacturer's recommended schedule.
- Replacements filters shall meet the originally-specified MERV and/or HEPA ratings.

C. Air Conditioning: Provide AHRI-rated and ENERGY STAR-qualified air conditioning equipment. Choosing the most energy-efficient ENERGY STAR-qualified equipment may qualify for CEEF incentives. Zoned, central air-conditioning systems with programmable indoor thermostats, with each zone having separate temperature and wired damper controls are preferred. Otherwise, room air-conditioners in through-wall sleeves shall be provided in living rooms and bedrooms. Where room air conditioners are provided, pre-manufactured, demountable insulated molded plastic air conditioner covers shall be provided on the interior side for use during cold weather months to prevent air infiltration.

D. CEE/AHRI Verified Directory: The Consortium for Energy Efficiency (CEE) and the AHRI have developed an online database which identifies high efficiency equipment that has been tested to ARI 210/240 and verified by AHRI. The CEE/AHRI Verified Directory identifies a list of equipment (less than 65 MBtuh) that the manufacturers represent as meeting energy performance tiers established by the CEE as part of the Residential Air-Conditioner and Heat Pump Initiative and the High-Efficiency Commercial Air-Conditioning Initiative. The CEE/AHRI Verified Directory lists equipment that meets the performance levels specified in the ENERGY STAR Central Air-Conditioner and Air-source Heat Pump Specification; however, only equipment listed by an ENERGY STAR partner are officially recognized as ENERGY STAR-qualified. The list of ENERGY STAR partners and the CEE/AHRI verified directory are available on the ENERGY STAR website.

ELECTRICAL

A. Emergency Generator: Except in buildings with multiple townhouses, an emergency generator shall be provided in any building with 4 or more dwelling units and 3 or more stories, to provide support for life safety systems for safe egress. Additionally, any building that is required to have a fire pump for the fire protection system shall be provided with an emergency generator, unless a diesel fire pump is provided. The emergency generator shall allow operation for a minimum of 24 hours. No underground storage tanks shall be used.

B. Lighting: Provide ENERGY STAR-qualified LED lighting in 90% of qualifying light fixture locations (min.).

a. Common area lighting shall be ENERGY STAR-qualified LED lighting;
b. Dwelling unit and common area kitchen lights shall be LED. Each kitchen shall have a task light above the sink, a LED light above the range (integrated into the range hood) and a centrally located general kitchen light; and,
c. Exit lights shall be ENERGY STAR-qualified LED or light-emitting capacitor (LEC) fixtures.

2. Provide automated lighting controls (sensors and timers) to turn lights off in unused areas or when lighting is not needed. Large multipurpose rooms and corridors shall be wired so that half of the fixtures may be shut off, and a uniformly reduced lighting level is achieved in the balance.