Enterprise green communities®

Multifamily Retrofit Toolkit

Enterprise green communities®

Step-By-Step Retrofit Process

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ABOUT THIS TOOLKIT AND THE STEP-BY-STEP RETROFIT PROCESS

Housing preservation, reliable and lower operating costs, improved indoor environmental quality, and reduced carbon emissions: all these benefit multifamily housing properties through retrofit.

Knowing how to select prime candidates for retrofit, though, along with aligning funding sources, selecting an audit protocol, ensuring proper implementation, and evaluating results is daunting for many portfolio managers. This toolkit distills Enterprise's experience retrofitting multifamily affordable housing into the critical steps necessary for success. What follows is a roadmap for multifamily housing owners, investors, and developers which outlines a comprehensive, cost-effective approach to retrofit.

How to Use the Toolkit

This step-by-step process can be used in three ways:

- **Portfolio Approach** - Assists you in developing an action plan to increase the efficiency of your portfolio through selective application of retrofits and related tools
- **Project Approach** - Assists you in taking one project through a streamlined, cost effective, efficient retrofit process
- **Midway through process and/or near completion** - Use as a toolkit at any point during the retrofit process in order to make smart and cost-effective decisions

The 9 Stages of the Retrofit Process with Resources

The resources provided here guide you through the stages of upgrading your portfolio or property. Each stage has specific directions with tools to assist you.

Location of the Toolkit

The documents, attachments and links referred to in this document can be found at: **www.enterprisecommunity.org/retrofittoolkit**

STEP-BY-STEP RETROFIT PROCESS

1 Review Portfolio

Use benchmarking to understand the energy use of your portfolio and guide decisions on capital upgrades.

To identify buildings with the greatest potential for energy, water efficiency and capital improvements, first benchmark your portfolio for operating expenses. Work with property management staff to collect and then input 12 months of historic utility consumption data in an online energy benchmarking and management tool. These tools compare your buildings to a national sample of similar buildings, helping you identify and select the least efficient properties in your portfolio and set priorities for use of your limited staff time and investment capital. You will ultimately be able to track changes in energy use over time for single buildings or groups of buildings, and track cost savings throughout the process. EPA Portfolio Manager, linked below, is a free online tool to help you get this process underway.

H Attachment

Benchmarking Tools – *includes links to:*

EPA Portfolio Manager
EnergyScoreCard
WegoWise

2 Secure Funding

Identify potential sources of capital for your portfolio improvements

The timeline from identification of a financing strategy to securing funding for retrofit upgrades can be complicated and can vary dramatically from a few months to one year depending on the funding sources. Which funding sources are available to you and your specific building portfolio will often guide your retrofit decisions. It is important to ask the right questions up front to ensure each property is appropriately matched with the capital to perform a retrofit. Enterprise has created a tool, the Financial Decision Tree, to assist owners in making funding decisions, along with the list of important questions below:

- What are the local, state and federal incentives or subsidies available for retrofits?
- What are the trends and higher-than-average utility expenses for the portfolio?
- What are the properties' partnership agreements, loan agreements, and audited financials for refinancing or recapitalization potential?
- What are the properties' regulatory agreements or requirements?
- Who are the point staff to present financial analyses for approvals?
- Are there complete capital needs assessments to estimate retrofit costs for financial analysis?

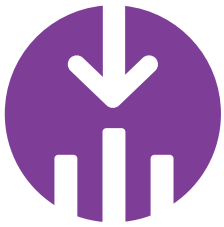
Attachment

Financial Decision Tree

Link

[Database of Energy Efficiency & Renewables Incentives & Rebates]

3 Select Property



Identify buildings with the greatest potential for energy, water efficiency and capital improvements.

On average, 20-25% energy savings can be achieved if retrofits are implemented on buildings poised for major systems upgrades. Informed by the portfolio utility benchmarking and financial analysis, use the threshold screening criteria and Property Screener tool below to prioritize your properties as good retrofit candidates.

- Building is older than 10 years
- Owner pays all bills (master metered)
- High energy intensity or Home Heating Index (HHI)
- High utility cost (spending over $1,000/unit a year)
- High maintenance/repairs costs for HVAC equipment
- Inefficient heating or cooling systems, appliances, lighting, or water fixtures (older than 10 years)
- Major piece of equipment slated for replacement within three years
- Available operating cash flow to payback retrofit improvements
- Property is positioned for recapitalization or refinance in the near term

Attachment

R **Property Retrofit Screener**

4 Select Audit Protocol

Select the appropriate protocol based on the funding source to obtain an investment grade audit.

Owner's objectives, funder/lender requirements and utility company rebate requirements will all influence the decision of which audit protocol to use. Enterprise has created two audit protocol standards that will yield an investment grade report: Use the Energy and Water Audit Protocol if the property can only finance energy and water upgrades. Use the Green Capital Needs Assessment Protocol if the property needs capital and energy/water upgrades and is in a position to refinance or resyndicate. Clearly state to your auditor your objectives as owner as well as the exact report parameters your funding source(s) requires:

Documents

Energy and Water Audit Protocol
Green Capital Needs Assessment Protocol

A – R Attachments

All attachments

Link

[Audit Examples]

5 Select Auditor and Conduct Audit

Obtain a quality auditor and final report with this guidance on auditor credentials and through a nationally screened list of Technical Assistance Providers.

An auditor will work directly with the owner to obtain 12-24 months of historical utility data, schedule an on-site property inspection, gain access to residential units for inspection, and schedule interviews with maintenance staff and the property manager. The preliminary audit report should come in a format agreed upon by the owner and should, at minimum, include recommendations for energy-efficiency, water conservation, capital improvements and indoor air quality improvements based upon the auditor's energy modeling, on-site inspections, resident and staff interviews, and analysis of the building's past performance. Select an auditor through a Request For Proposal process; the criteria below provide guidance for auditor qualifications. The Technical Assistance Database linked below provides a list of nationally screened TA providers, including multifamily energy auditors.

Criteria to select an auditor:

- Ability to follow the Enterprise audit protocols with templates, and create report using these materials
- Experience in energy auditing and physical needs assessments for multifamily housing
- Experience using the energy modeling software and diagnostic testing prescribed in the referenced audit protocol
- Experience assessing feasibility of renewable energy installations
- Experience conducting financial analysis and cost estimates that generate investment-grade level information (replacement reserve, life cycle cost, simple payback, SIR analysis)
- Evidence of a qualified team to execute all components (i.e., CNA Provider, Energy Auditor, Energy Modeler, Architect, etc.)
- Sufficient capacity to complete the scope of work
- Ability to perform post-retrofit inspections as per the Quality Assurance and
- Verification Measures Guidelines (optional)

Step 5 continued:

We recommend that the auditor or team has the following certifications:

- Building Performance Institute (BPI) multifamily analyst
- Certified Energy Manager (CEM)
- Licensed mechanical engineer
- Licensed electrical engineer
- Energy modeler
- General contractor
- Certified Green Building Professional
- Home Energy Rating System (HERS) Rater
- Retro-commissioning agent
- Renewable energy expert
- Licensed architect
- Financial expert
- Integrated Pest Management professional

Link

Technical Assistance Provider Database – includes vetted GCNA Providers

6 Determine Final Scope of Work and Select Contractor to Complete Renovation

Work with the auditor and team to tailor the final retrofit scope of work based on the audit report and available financing. Hire a high-quality contractor to establish construction framework that ensures installed measures meet the audit report specifications.

The owner's team (property manager, asset management staff and possibly general contractor, trades, architect, engineer) provides feedback on the financial and physical feasibility of the audit report's proposed measures. Once the owner's team has completed a Bid Set including drawings, engineering calculations and product specifications that meet the auditor's performance criteria, a general contractor and/or trades can provide pricing. Often the contractors will have suggestions or revisions based on actual field conditions or code requirements. These revisions can be incorporated into the set of drawings that is submitted to the Building Department for permitting. The Building Department may provide another round of revisions that will need to be incorporated into the final Permit Set of construction documents.

It is critical to hire a high-quality, experienced contractor to draft a comprehensive scope so that the measures as installed meet the equipment and performance specifications outlined in the audit report. This will help to guarantee that the predicted savings are realized. Enterprise has created a Construction Flow Chart that outlines a more comprehensive construction process to ensure the whole team verifies that the retrofit upgrades are specified and installed properly. Below are steps to determine the final scope of work to include in the construction process:

1. Meet with auditor, property management, asset management and operations & maintenance staff to review the audit results
2. Evaluate the auditor's recommended measures, factoring in any capital reserve planning
3. Evaluate the auditor's recommendations in light of any plans to refinance and/or resyndicate

Step 6 continued:

4 Calculate any collateral costs associated with each measure that are not factored into the auditor's costs (i.e., removal/disposal of existing equipment, resident impact/relocation, disturbance of asbestos/lead paint)

5 Translate the final retrofit scope into construction documents

Attachments

P **Construction Flow Chart**

Q **Construction Management Checklist**

7 Conduct Quality Assurance and Verification (QA&V)

Hire a third party to conduct Quality Assurance and Verification to ensure retrofit measures are installed properly and that predicted savings are realized.

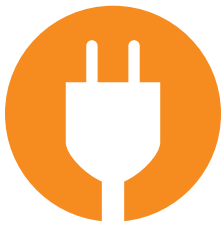
It is recommended that the owner hire a third party to conduct quality assurance and verification (QA&V). These third-party QA&V tests will verify that the renovations improved the building's condition according to plan. The Enterprise QA&V Guidelines by Measure Table outlines the testing and reporting activities to be completed. Consider engaging the same consultant as QA&V Provider that conducted the building's initial audit. What to consider when choosing a QA&V Provider:

- Experience in energy auditing and providing QA&V services to multifamily housing
- Evidence that a team is assembled to carry out the various components prescribed in the QA&V Guidelines by Measure
- Sufficient staff and/or team capacity according to the project's location and expected timeframe
- Ability to provide competitive pricing

Attachment
Quality Assurance and Verification Guidelines by Measure

Link
Technical Assistance Provider Database

8 Monitor Utility Use



Perform ongoing monitoring of utility usage to ensure that projected savings are realized.

Energy benchmarking and management tools will help you:

- Evaluate how actual savings compare to predictions post-retrofit
- Monitor the ongoing health of your portfolio
- Manage operating costs as energy prices fluctuate

With knowledge of ongoing operating expenses, you can strategically plan to manage buildings that are highly inefficient, incorporate better practices for average buildings, and replicate practices employed in efficient buildings. Regular and standardized energy data collection plays an important role in portfolio management. The Residential Energy and Water Data Collaborative (REWDC) has found tracking of utility consumption data to be important for a number of reasons which are discussed at length in their white paper (LINK: **http://www.enterprisecommunity.com/servlet/servlet.FileDownload?file=00P30000009w72REAQ**). These include:

- Establishing performance benchmarks
- Identifying cost-effective improvements
- Influencing lending and investment decisions
- Supporting policy and regulatory changes
- Proving value for building owners beyond cost savings
- Engaging property owners and residents in realizing utility cost savings from green behavior, measures and improvements

Step 8 continued:

Enterprise created a template data collection form to align your portfolio with an online benchmarking and energy management tool. The links below direct you to a selection of online benchmarking systems to help you ensure your portfolio's sustained health.

Attachments

- G **Utility Release Form**
- H **Benchmarking Tools** – *includes links to:*

EPA Portfolio Manager
EnergyScoreCard
WegoWise

9 Management, Operations and Maintenance

Ensure that management practices, ongoing maintenance and resident actions support the optimal performance of the newly installed green features.

Sustaining efficient building operations is a challenging task and requires coordinated effort in all aspects of housing operations, from management to maintenance staff. Often, additional 5-10% savings can be achieved without physical building changes, but through better building operations and maintenance processes and resident education and empowerment. Enterprise O&M and Resident Engagement Tools will assist you in identifying behavior-based portfolio and building challenges, as well as best practices to improve operations and maintenance practices and effective ways to engage residents. The Enterprise "Training in a Box" tools include resources to help residents and staff understand the purpose and operations of the new features in their buildings. Using these templates will ensure that ongoing maintenance staff and resident behavior support optimal performance of the newly installed green features. At all costs, adopting portfolio-level utility management strategies along with staff and resident behavior best practices, should be prioritized.

Links

- Resident Engagement Training in a Box
- Green Leader Toolkit
- Operations & Maintenance Training in a Box

General data collection process:

Data Collection

- Collect 12-24 months of historical consumption data
- Input property information and data into specified format
- Gather utility logins and authorizations Set up ongoing utility data retrieval or manual entry
- Enter information on recent upgrades

Initial Benchmark and Training

- Analyze historical usage
- Use energy software provider to train users

Ongoing Monitoring and Reporting

- Establish internal utility tracking and review process
- Address data issues as needed
- Establish annual energy performance reviews
- Establish portfolio utility performance tracking

OVERVIEW OF THE MULTIFAMILY RETROFIT TOOLKIT

The Multifamily Retrofit Toolkit is composed of a variety of different parts – which are listed below. These resources can be found at **www.enterprisecommunity.org/retrofittoolkit**

Documents

The main toolkit is made up of four core documents:

- Step-By-Step Retrofit Process
- Energy and Water Audit Protocol
- Green Capital Needs Assessment Protocol
- Frequently Asked Questions

Attachments

Referenced within the documents are these supporting attachments:

- **A** Green Capital Needs Assessment Summary Table
- **B** On-Site Visit Guidelines
- **C** Site Visit Preparation
- **D** Potential Operations & Maintenance Problem Worksheet
- **E** Inspection Worksheet
- **F** Equipment Specifications Worksheet
- **G** Utility Release Form
- **H** Benchmarking Tools
- **I** Diagnostic Testing Guidelines
- **J** Energy & Water Analysis Guidelines
- **K** Energy Modeling Reporting Requirements
- **L** Energy Modeling Input Assumptions Table
- **M** Integrated Pest Management Guidelines
- **N** Quality Assurance & Verification Guidelines
- **O** Financial Decision Tree
- **P** Construction Flow Chart
- **Q** Construction Management Checklist
- **R** Property Retrofit Screener

Links

Referenced within the documents are links to important resources:

- Database of Energy Efficiency & Renewables Incentives & Rebates
- Technical Assistance Provider Database
- Fannie Mae Green Refinance Plus Program
- Enterprise Utility Allowance Resource Guide
- National Center for Healthy Housing Resource Library
- Green Capital Needs Assessment Example
- Housing Partnership Networks (HPN) Group Buying Program

Referenced within the documents are additional toolkits which support the Retrofit Process:

- Resident Engagement Training in a Box
- Green Leader Toolkit
- Operations & Maintenance Training in a Box

CREDITS

About Enterprise Green Communities

Enterprise Green Communities is the first national green building program focused entirely on affordable housing. Launched by Enterprise in fall 2004, Green Communities is designed to help developers, investors, builders and policymakers make the transition to a greener future for affordable housing.

Visit **www.enterprisecommunity.org/green** to learn more about Enterprise Green Communities.

About Enterprise

Enterprise is a leading provider of the development capital and expertise it takes to create decent, affordable homes and rebuild communities. For more than 30 years, Enterprise has introduced neighborhood solutions through public–private partnerships with financial institutions, governments, community organizations and others that share our vision. Enterprise has raised and invested more than $11.5 billion in equity, grants and loans to help build or preserve nearly 300,000 affordable rental and for-sale homes to create vital communities. Enterprise is currently investing in communities at a rate of more than $1 billion a year. Visit **www.enterprisecommunity.org** to learn more about Enterprise's efforts to build communities and opportunity.

ACKNOWLEDGEMENTS

The Enterprise Multifamily Retrofit Toolkit was overseen by the Enterprise Green Communities team. Special thanks to all the Enterprise staff who provided valuable input.

We also thank Dana Bourland for her early oversight and vision in the creation of this toolkit. Many thanks to Fran Hereth for her technical oversight and expertise in the creation of each protocol and associated tool, and for the many technical assistance providers who thoroughly reviewed each component.

Special thanks to Worldstudio for design and to the local Enterprise markets for coordinating the development of the tool. Any errors in this report are the sole responsibility of Enterprise.

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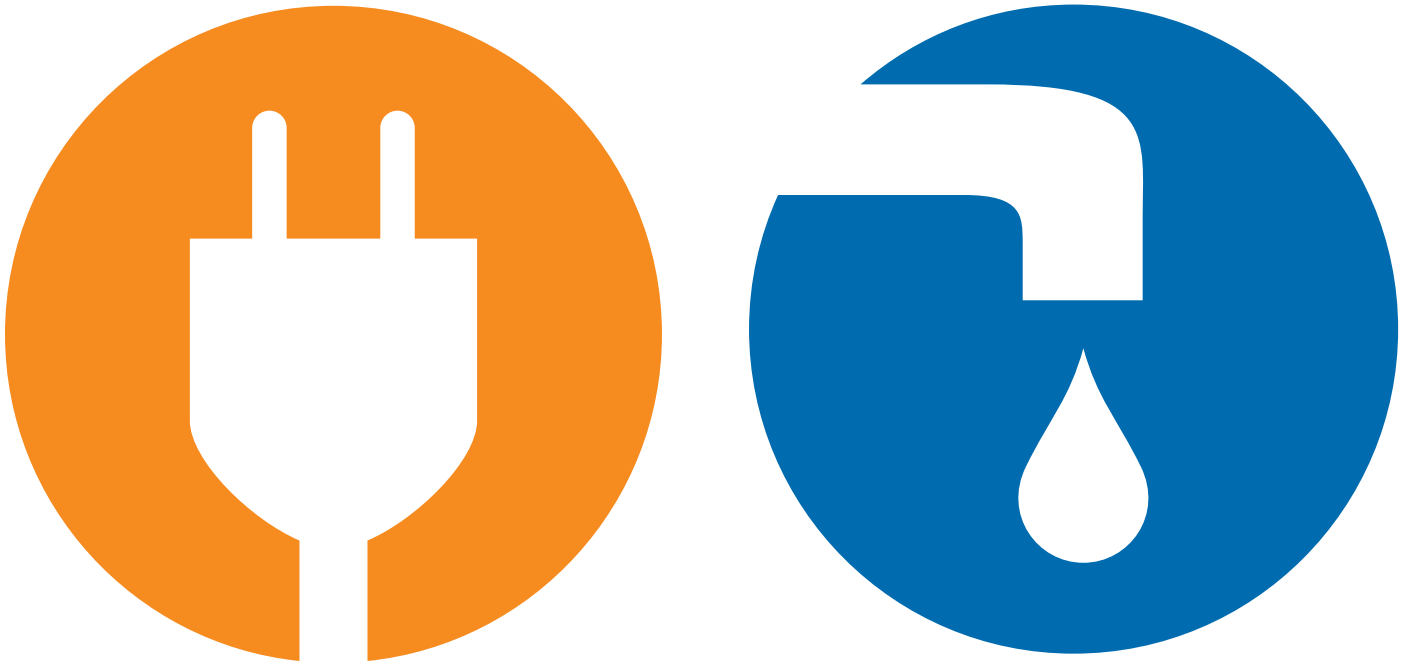
Energy and Water Audit Protocol



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Note: The attachments referred to in this section can be found at **www.enterprisecommunity.org/retrofittoolkit**

OVERVIEW

The Enterprise Community Partners **Energy and Water Conservation Audit Protocol** ("the EWCM Protocol") is a tool that defines the required criteria for an audit to be used by property owners and underwriters. It identifies ways to save the maximum amount of energy and water at a property as cost efficiently as possible with an outcome that results in:

1. Reduced operating costs through increased energy and water efficiency
2. Healthier living environments by improving indoor air quality for residents
3. Decreased carbon emissions by reducing the property's environmental impact

The EWCM Protocol ensures a quality report by providing templates and guidance to conduct a holistic assessment. The outcome is an investment-grade report that includes rigorous data analysis and financial analysis for each recommended measure. In the end, you'll know which product to use, when to install it, and how much you will save.

The Energy Audit will include:

- Current Energy Use and Cost
- Total Reduction in Energy Use and Cost for Recommended Measures
- Energy and Water Conservation Measures (EWCMs) that could be installed
- Green Measures (GMs) that improve comfort, indoor air quality, and safety with diagnostic testing results, if needed, that could be installed
- Life Cycle Cost Analysis and Estimated Useful Life (EUL) for each recommended measure
- Financial payback of each measure using net present value (NPV), internal rate of return (IRR), savings to investment ratio (SIR), and simple payback
- Methodology for data collection, energy modeling software and assumptions used to make the projections
- Qualifications and certifications of all those who worked on the audit
- Representation that the Audit meets the Enterprise Audit Protocol as defined here

The main process that constitutes the EWCM Protocol includes:

- On-site visit
- Energy Analysis
- Financial Analysis
- Reporting

This Protocol is derived from the following standards: Building Performance Institute, Inc. Technical Standards for Multifamily Building Analyst (2008); HERS II 2008 Technical Manual; California Title 24-2008; HUD, Energy Conservation for Housing; A Workbook; RESNET, ASHRAE; Fannie Mae Green Refinance Plus: Green PNA (2011)

AUDITOR QUALIFICATIONS

The Protocol requires that auditors perform, at a minimum, the following tasks:

- Energy modeling
- Building assessment (limited to identifying safety, code and durability issues)
- **Diagnostic Testing Guidelines** (*Attachment I*)
- Combustion appliance safety testing
- Feasibility analysis for the installation of renewable energy retrofits
- Construction cost estimating
- Financial analysis that generates investment grade level information/data (SIR, LLC and simple payback)

In recognition that a single firm may not be able to fulfill all the requirements of this audit protocol, multi-disciplinary teams assembled for their complementary skill sets are welcome to apply. Applicants who do not hold these certifications but can prove equivalent training and experience will be considered on a case-by-case basis by Enterprise. Potential team members may include, but are not limited to:

- BPI multifamily analyst
- Certified Energy Manager (CEM)
- Mechanical engineer
- Electrical engineer
- Energy modeler
- General contractor
- Certified green building professional
- HERS rater
- Retrocommissioning agent
- Renewable energy expert
- Architect
- Financial expert

ON-SITE VISIT

Prior to the on-site visit, we suggest that a pre-audit meeting or conference call be conducted with the following parties:

- Auditor and their team members
- Owner (to include property operations and maintenance staff)
- Local jurisdictional staff (optional)

We recommend that the pre-audit meeting occur prior to finalizing the contract for audit services with the owner.

The purpose of the pre-audit meeting is to establish and confirm the understanding of the following variables:

- Diagnostic testing to be conducted
- Any previous PNAs or audits done on the property
- Energy modeling software to be used, and the outcome that will be reported in the final audit document
- Wage rates to be factored into the construction cost estimates
- If any subsidy or incentive funds may be involved in the project, discuss requirements that will impact the audit inspection, testing and written report

The **on-site visit** will take place on the day of the site inspection. The purpose of the on-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 and financial analysis. The intent is to interview property owners and managers, evaluate the building envelope, assess building airflow, inventory HVAC equipment, identify ventilation system, field verify fan operation, and perform other diagnostic testing.

Attachments

A Green Capital Needs Assessment Summary Table
I Diagnostic Testing Guidelines

ENERGY MODELING AND ANALYSIS PROCESS

An energy model of the building's pre- and post-retrofit performance shall be completed using utility data, building plans, initial inspection data and diagnostic data collected during the on-site visits. The energy model is used to estimate annual energy consumption, carbon savings and energy cost savings of potential energy conservation measures. Current operating schedules verified on site are to be used for energy and energy cost savings estimates. Software to be used on site shall be either EnergyPro, TREAT or other as approved by Enterprise.

All major assumptions used to develop the energy model and analysis must be clearly stated in the final report. Reporting emphasis should be placed on the assumptions that have the most impact on estimated energy savings. Occasionally, some building features may be inaccessible, such as wall and attic insulation. When certain building features cannot be physically verified, the default conditions should be identified as well as the justification for them.

Attachments

- K **Energy Modeling Requirements Guidelines**
- J **Energy & Water Audit Guidelines** provides more details on the energy modeling and analysis process.

ENERGY AND WATER AUDIT REPORT

The auditor shall prepare a written report which will have the following features:

EXECUTIVE SUMMARY

The Executive Summary shall summarize the major findings of the audit, including:

- Basic building characteristics
- Overall physical condition of the building
- Recommended energy efficiency and water conservation measures
- Recommended green measures and other capital improvements
- Cost Estimate to install each recommended measure. Must use RS Means, plus local adjuster, plus Davis Bacon wage rates and verify with available current data from auditor or owner
- An excel spreadsheet of all recommended measures and their costs to accompany the report
- Projected savings from implementing each EWCM both in dollars and KWh and Therm
- Comparison of total projected savings to existing energy use/cost
- Savings to Investment Ratio (SIR) of each measure

SITE VISIT BACKGROUND

This section includes information on weather conditions, site visit participants, unit sampling, documents (e.g., as-built plans) and records (e.g., Operations and Maintenance reports provided by the owner).

NARRATIVE

This section shall include a written narrative that describes existing property conditions and organized into the following categories:

- Site systems
- Mechanical/electrical
- Electrical
- Architecture
  - Building exterior
  - Roof systems
  - Building interior common areas
  - Community rooms, kitchens, lobbies, corridors, commercial spaces
- Dwelling units
  - Living area finishes
  - Bathrooms
  - Kitchens
  - In-unit mechanical
  - In-unit electrical

In the narrative, the auditor shall include information from the site visit to verify the building drawings. If the site conditions do not match design conditions, the site conditions shall be used for analysis and reporting (BPI Standard 3.3 Blueprint Evaluation/Site Visit). This section will include information on equipment specifications in accordance with **Equipment Specifications Worksheet** (*Attachment F*).

RECOMMENDATIONS This section will provide information on each recommended measure and improvement, including but not limited to:

- Description of measures and recommended loading order
- Rationale for recommendation
- Estimated useful life of existing component
- Recommendation for timing of implementing the measure/replacement/improvement
- Identification of how cost estimate was derived (including source of cost information, unit pricing, take-off used)
- In the absence of renewable energy opportunities, explain why these are not recommended
- Non-energy related benefits of the recommended measures such as health and safety, improved indoor air quality and increased resident comfort

A Auditors will present this information in the **Green Capital Needs Assessment Summary Table** (*Attachment A*) that includes the most cost-effective combination of recommended measures and improvements factoring in loading order, available funding, estimated useful life of existing equipment/systems and the property owner's goals.

This section will include the results of the diagnostic testing conducted on site and describe how the test results informed the rationale for the above recommendations. Auditors may also offer recommendations for the retrocommissioning of certain existing equipment based on diagnostic test results.

This section of the report will also include a summary of the combustion analysis testing completed during the energy audit. For all audited dwelling units, include the results of combustion safety testing and identify if action was warranted as a result of the combustion safety testing. Report recommendations to include CO detectors to the extent the dwelling units don't have them installed.

Additional attachment

I **Diagnostic Testing Guidelines**

ENERGY AND WATER AUDIT REPORT

ENERGY AND WATER COST/BENEFIT ANALYSES	This section shall include the individual cost/benefit worksheets for each recommended energy efficiency and water conservation measure. The worksheets should show implementation cost, energy and water consumption and financial savings, simple payback and incremental payback (as applicable).
PHOTO DOCUMENTATION	This section of the report should include photo documentation of the subject property, specifically targeted toward describing the relevant physical conditions and energy efficiency and water conservation measures.
QUALITY ASSURANCE AND VERIFICATION	This section shall include a written plan that outlines the recommended process for the visual inspection of all newly installed components, and verification of their performance both at the completion of construction and 12 months thereafter. This plan shall be in accordance with the **Quality Assurance and Verification Guidelines**, (*Attachment N*)
QUALIFICATIONS AND CERTIFICATIONS	This section shall include a description of the qualifications and professional certification of all those who worked to produce the plan.
REPRESENTATION	This section shall include a representation from an officer or owner of the firm conducting the audit that the audit meets the **Enterprise Multifamily Green Retrofit Program Energy and Water Audit Protocol** without exception and that the final audit report has been reviewed for quality assurance purposes by a principal or officer of the firm.

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Green Capital Needs Assessment Protocol

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B C D E F I J K L G A N M

Note: The attachments referred to in this section can be found at **www.enterprisecommunity.org/retrofittoolkit**

OVERVIEW

The Enterprise Community Partners **Green Capital Needs Assessment Protocol** ("the GCNA Protocol"), created in partnership with RECAP Real Estate Advisors (http://on-site-insight.com/), is a tool that combines a conventional 20-year Capital Needs Assessment with an energy audit to be used by property owners and underwriters. These two identify ways to save the maximum amount of energy and water at a property and capital improvements as cost efficiently as possible with an outcome that results in:

1. Reduced operating costs through increased energy and water efficiency
2. Healthier living environments by improving indoor air quality for residents
3. Decreased carbon emissions by reducing the property's environmental impact

The GCNA Protocol ensures a quality report by providing templates and guidance to conduct a holistic assessment. The outcome is an investment grade report that includes rigorous data analysis and financial analysis for each recommended measure. In the end, you'll know which product to use, when to install it, and how much you will save.

The GCNA includes:

- Standard CNA with 20-year capital needs projections
- Replacement Reserve analyses for both green and conventional measures
- Side-by-side comparisons of Conventional and Green capital needs
- Current Energy Use and Cost
- Total Reduction in Energy Use and Cost for Recommended Measures
- Energy and Water Conservation Measures (EWCMs) that could be installed
- Green Measures (GMs) that improve comfort, indoor air quality and safety with diagnostic testing results, if needed, that could be installed
- Life Cycle Cost Analysis and Estimated Useful Life (EUL) for each recommended measure
- Financial payback of each measure using net present value (NPV), internal rate of return (IRR), savings to investment ratio (SIR), and simple payback
- Methodology for data collection, energy modeling software and assumptions used to make the projections
- Qualifications and certifications of all those who worked on the audit
- Representation that the Audit meets the Enterprise Audit Protocol as defined here

The main process that constitutes the GCNA Protocol includes:

- On-site visit
- Energy Analysis
- Financial Analysis
- Reporting

This GCNA Protocol is derived from the following standards: Building Performance Institute, Inc. Technical Standards for Multifamily Building Analyst (2008); HERS II 2008 Technical Manual; California Title 24-2008; HUD, Energy Conservation for Housing; A Workbook; RESNET, ASHRAE; Fannie Mae Green Refinance Plus: Green PNA (2011)

GREEN CAPITAL NEEDS ASSESSMENT FIRM QUALIFICATIONS

The Green Capital Needs Assessment Protocol requires that auditors perform the following tasks:

- Energy modeling and/or energy analysis
- Building assessment
- Replacement reserve analysis
- Diagnostic testing
- Combustion appliance safety and indoor air quality testing
- Feasibility analysis for the installation of renewable energy retrofits
- Construction cost estimating
- Financial analysis that generates investment-grade-level information SIR, life cycle cost analysis, simple payback
- Integrated pest management plan inspection

In recognition that a single firm may not be able to fulfill all the requirements of this audit protocol, multi-disciplinary teams can be assembled for their complementary skill. Potential team members may include, but are not limited to:

- BPI multifamily analyst
- Certified Energy Manager (CEM)
- Licensed mechanical engineer
- Licensed electrical engineer
- Energy modeler
- General contractor
- Certified green building professional
- Home Energy Rating System (HERS) rater
- Retro commissioning agent
- Renewable energy expert
- Licensed architect
- Financial expert
- QualityPro Green, GreenShield or EcoWise-trained pest management professional

ON-SITE VISIT

Prior to the on-site visit, we suggest that a pre-audit meeting or conference call be conducted with the following parties:

- Auditor and their team members
- Owner (to include property operations and maintenance staff)
- Local jurisdictional staff (optional)

We recommend that the pre-audit meeting occur prior to finalizing the contract for audit services with the owner. The purpose of the pre-audit meeting is to establish and confirm the understanding of the following variables:

- Owner expectations and prioritization of building improvements
- Historical utility data (at least 12 consecutive months and ideally 24 consecutive months)
- As-built drawings from the original construction and any rehabilitations
- Recent operations and maintenance issues (i.e., leaks, indoor air quality, pests)
- Diagnostic testing to be conducted, if applicable
- Any previous PNAs or audits done on the property
- Energy modeling software to be used, and the outcome that will be reported in the final audit document
- Wage rates to be factored into the construction cost estimates, if applicable
- If any subsidy or incentive funds may be involved in the project, discuss requirements that will impact the audit inspection, testing and written report

ON-SITE VISIT

The **on-site visit** will take place on the day of the site inspection. The purpose of the on-site visit is to collect all necessary information to conduct an appropriate energy, water, physical condition, health, and environmental analysis, including sufficient information to inform an energy model and financial analysis. The intent is to interview property owners and managers, evaluate the building envelope, assess building airflow, inventory HVAC equipment, identify ventilation system operations, field verify fan operation, and perform other diagnostic testing.

Attachments

- B **On-Site Visit Guidelines**
- C **Site Visit Preparation**
- D **Potential Operations & Maintenance Problem Worksheet**
- E **Inspection Worksheet**
- F **Equipment Specifications Worksheet**
- I **Diagnostic Testing Guidelines**

ENERGY MODELING AND ENERGY/WATER SAVINGS ANALYSIS

An energy model of the building's pre- and post-retrofit performance shall be completed using utility data, building plans, initial inspection data and diagnostic data collected during the on-site visits. The energy model is used to estimate annual energy consumption, carbon savings and energy cost savings associated with each potential energy conservation measure. Current operating schedules verified on site are to be used for energy and energy cost savings estimates. Software to be used shall be either EnergyPro, TREAT or other as approved by Enterprise.

All major assumptions used to develop the energy model and analysis must be clearly stated in the final report. Reporting emphasis should be placed on the assumptions that have the most impact on estimated energy savings. Occasionally, some building features may be inaccessible, such as wall and attic insulation. When certain building features cannot be physically verified, the default conditions should be identified as well as the justification for them.

Attachments

- J **Energy and Water Audit Guidelines**
- K **Energy Modeling Reporting Requirements**
- L **Energy Modeling Input Assumptions Table** for more details on the energy modeling and analysis process
- G **Utility Release Form** for guidance on collecting utility data from residents

GREEN CAPITAL NEEDS ASSESSMENT REPORT

EXECUTIVE SUMMARY

The Executive Summary shall summarize the major findings of the audit including:

- (A) Recommendations – **Green Capital Needs Assessment Summary Table** (*Attachment A*)
- Green Capital Needs Assessment Overview
- Project summary & description
- Critical repairs
- Non-critical repairs
- Near term replacement reserve summary years 1-10
- Long term replacement reserve summary years 11-20, if applicable

SITE VISIT BACKGROUND

This section includes information on weather conditions, site visit participants, unit sampling, documents (e.g., as-built plans) and records (e.g., Operations and Maintenance reports provided by the owner).

NARRATIVE

This section includes information on existing conditions, description of the conventional replacement measure and description of the green alternative (EWCMs and GMs) organized into the following categories:

- Site systems
- Mechanical/electrical
- Electrical
- Architecture
  - Building exterior
  - Roof systems
  - Building interior common areas
  - Community rooms, kitchens, lobbies, corridors, commercial spaces
- Dwelling units
  - Living area finishes
  - Bathrooms
  - Kitchens
  - In-unit mechanical
  - In-unit electrical

ENERGY AND WATER AUDIT ANALYSIS

This section of the narrative should describe:

- Energy and water analysis methodology
- Utility analysis and end-use breakdown
- Source of information
- L • **Energy Modeling Input Assumptions Table** (*Attachment L*)
- Energy model documentation
- Energy savings summary
- Equipment (HVAC, DHW) sizing methodology
- Benchmarking (if applicable)

Additional attachments

J **Energy and Water Audit Guidelines**

K **Energy Modeling Requirements**

RECOMMENDATIONS This section will provide information on Energy Efficiency, Water Conservation, Health, Green and Capital Improvement, including but not limited to:

- Description of measures and recommended loading order
- Rationale for recommendation
- Estimated useful life of existing component
- Recommendation for when to implement the measure/replacement/improvement
- Identification of how cost estimate was derived (including source of cost information, unit pricing, take-off used)
- In the absence of renewable energy opportunities, explain why these are not recommended
- Non-energy related benefits of the recommended measures such as health and safety, improved indoor air quality and increased resident comfort

A Auditors will present this information in the **Green Capital Needs Assessment Summary Table** (*Attachment A*) that includes the most cost-effective combination of recommended measures and improvements factoring in loading order, available funding, estimated useful life of existing equipment/systems and the property owner's goals.

This section will include the results of the diagnostic testing conducted on site and describe how the test results informed the rationale for the above recommendations. Auditors may also offer recommendations for the retrocommissioning of certain existing equipment based on diagnostic test results.

This section of the report will also include a summary of the combustion analysis testing completed during the energy audit. For all audited dwelling units, include the results of combustion safety testing and identify if action was warranted as a result of the combustion safety testing. Report recommendations to include CO detectors to the extent the dwelling units don't have them installed.

Additional attachment

I **Diagnostic Testing Guidelines**

CODE COMPLIANCE

This section documents any issues related to compliance with all applicable codes and regulations including local Building Code, Local Housing Code, Americans with Disabilities Act-Title III, Fair Housing Accessibility Guidelines, Life Safety Code/ National Fire Protection Association (NFPA), Minimum Property Standards (MPS) HUD Handbook 4910.1 and Uniform Federal Accessibility Standards (UFAS)/ Section 504.

REPLACEMENT COST CALCULATIONS

Provides details on the methodology used to derive the calculations and the final values.

QUALITY ASSURANCE AND VERIFICATION (QA&V) PLAN

N

If applicable, this section shall include a written QA&V plan specific to the subject property. The plan shall include requirements for inspections, documentation and performance test-outs. Refer to **Quality Assurance and Verification Guidelines** (*Attachment N*).

WHOLE BUILDING ENERGY CONSUMPTION DATA

The auditor shall evaluate the feasibility of installing a master meter for the property, in cases where the tenant spaces are individually metered and whole building consumption data is unavailable directly from the utility; or evaluate another cost-effective method to deliver whole building energy consumption data to the owner on a monthly basis, at a minimum. The auditor must collect data in the attached form.

Additional attachments

G **Utility Release Form**

INTEGRATED PEST MANAGEMENT PLAN INSPECTION

A qualified Contractor, certified by QualityPro Green, GreenShield or EcoWise will perform an Integrated Pest Management Plan Inspection (IPMI). The contractor, during the first site visit, will interview property management about existing pest control practices, place glue traps and schedule a date to retrieve the traps. Based on the results of the glue trap evidence, the contractor will conduct targeted unit and property inspections during a second visit. The contractor will submit a narrative report that describes the inspection process and results, identifies deficiencies in the current pest control strategies and practices and recommends practices that adhere to Integrated Pest Management principles and achieve better outcomes.

The inspection process and reporting requirements are described in more detail in

M **Integrated Pest Management Guidelines** (*Attachment M*)

CERTIFICATION/ REPRESENTATION

This section includes a representation from an officer or owner of the audit firm that the audit meets the Enterprise Green Capital Needs Assessment Protocol without exception and that the final audit report has been reviewed for quality assurance purposes by a principal or officer of the firm.

APPENDICES

- Capital needs schedules
- Replacement reserve analysis
- Property photographs
- HUD forms 92329 and 92264 (if applicable)
- Site map
- Municipal compliance letters

L • **Energy Modeling Input Assumptions Table** (*Attachment L*) completed

G • **Utility Release Form** (*Attachment G*)

A • **Green Capital Needs Assessment Summary Table** (*Attachment A*)

- Payback analyses for each measure comparing green to conventional
- Integrated pest management report and exhibits

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Frequently Asked Questions

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Note: The attachment referred to in this section can be found at www.enterprisecommunity.org/retrofittoolkit

FREQUENTLY ASKED QUESTIONS

1. WHAT IS A GREEN CAPITAL NEEDS ASSESSMENT?

The Green Capital Needs Assessment (GCNA) Protocol is a tool that Enterprise and Recap Advisors (http://www.on-site-insight.com) developed to help integrate green retrofits into the capital improvement, modernization and financial planning processes routinely undertaken by multifamily owners. The GCNA Protocol predicts the return-on-investment from energy efficiency expenditures, evaluates the optimal timing of investments based on life-cycle-cost analyses and provides a savings-to-investment ratio calculation. These metrics help owners and lenders evaluate individual measures and select the package of measures that best meets the various and sometimes competing goals of a retrofit project.

The GCNA not only looks at energy and water conservation measures but includes green alternatives to all the standard components to be replaced (e.g., cabinets and flooring).

Document

Green Capital Needs Assessment Protocol

Links

▶ Green Capital Needs Assessment Example

2. WHEN IS THE OPTIMAL TIME TO RETROFIT A BUILDING?

The optimal time to retrofit a building varies depending on:

Available funding/financing

- Condition of the existing building
- Available building reserves
- Plans for refinancing and/or recapitalization
- Cashflow
- Available capital reserves
-

Retrofit work can be implemented to take advantage of time-limited funding (e.g., utility rebates/incentives) for plug-and-play components such as lighting and plumbing fixtures.

More comprehensive, whole-building retrofits can be integrated into properties that are being refinanced and/or resyndicated. Proceeds from the refinancing can pay for the retrofit improvements. The loan principal amount, debt service coverage and loan-to-value ratios can be adjusted to factor in the added loan proceeds generated from the energy savings.

Ideally retrofit work is proactively integrated into the capital improvement planning for an entire portfolio driven by a whole-building approach rather than being triggered by one-time funding that results in a fixture-by-fixture, building-by-building, "chase-the-money" approach.

Link

▶ **Fannie Mae Green Refinance Plus Program**

3. WHAT IF MY BUILDING IS INDIVIDUALLY METERED?

In individually metered buildings the financial savings generated by energy/water conservation measures installed in the units will accrue to the residents rather than to the owner who paid for them. This mismatch of investment and benefits is called the split incentive.

One approach to overcoming the split incentive challenge is to lower the standard HUD utility allowances and increase rents based on the utility savings. The savings can be shared between the owner and the residents. An energy-efficiency based utility allowance (EEBUA) can be based on actual utility data or on an energy consumption model for a specific building.

In California, 20 Public Housing Authorities have adopted EEBUAs which lower the utility allowance for both new construction and rehab projects.

The California Energy Commission worked with the affordable housing community and the California Tax Credit Allocation Committee to support the development of an energy modeling tool to more accurately project residents' actual utility costs in a specific building. A link to this tool, known as the California Utility Allowance Calculator, is provided below.

In addition, Enterprise created a *Utility Allowance Resource Guide*. The purpose of this resource is to increase awareness by affordable housing developers, building owners, public housing authorities (PHA) and housing finance authorities (HFA) about adopting, establishing and offering utility allowance options supportive of energy-efficiency investments in new construction and rehabilitation projects.

Attachment

G **Utility Release Form**

Link

▶ **Enterprise Utility Allowance Resource Guide**

4. HOW DO I KNOW WHICH AUDIT PROTOCOL TO USE?

Owner's objectives, funder/lender requirements and utility company rebate requirements will all influence the decision on which audit protocol to use. The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) defines three levels of audits:

Level 1-Walk-Through Analysis
- Level 2-Energy Survey and Analysis
- Level 3-Detailed Analysis of Capital-Intensive Modifications
-

An Investment Grade Audit represents a fourth level of audit (see link to Enterprise Energy and Water Audit Protocol listed below). An Investment Grade Audit is used by loan underwriters to determine if energy and water conservation measures generate sufficient savings to make payments on a loan that finances all, or some portion of, the improvements.

Early on in the process it's important to talk with everyone involved to ensure that the selected audit protocol will address both the owner's objectives and the funders' requirements.

Documents

Energy and Water Audit Protocol
Green Capital Needs Assessment Protocol

5. HOW DO I KNOW WHICH RETROFIT MEASURES WILL BE MOST COST-EFFECTIVE FOR A PARTICULAR BUILDING?

An Energy Audit analyzes a building's energy and water usage and recommends retrofit measures which will most effectively reduce usage while preserving and even improving the health, safety, durability and comfort of the building.

Tiered improvements are outlined below:

Short-term payback (less than three years) These "low-hanging fruit" measures include:

- Lighting, appliances, boiler controls and weatherization
- Replace standard T12 fluorescent bulbs with T8s
- Replace fluorescent magnetic ballasts with electronic ones
- Install energy-efficient appliances
- Install boiler controls
- Weatherize the building including insulating, caulking and weather-stripping

Medium payback (3-5 years)

- Replace incandescent and fluorescent exit signs with LED (Light Emitting Diode)
- Replace standard incandescent with CFL (compact fluorescent lamps)

Longer-term payback These measures are more capital-intensive such as:

- System equipment replacement, windows
- Domestic hot water heaters
- Space heating boilers
- Air conditioners
- Heat pumps
- Chillers
- Windows
- Renewable systems such as solar domestic hot water and solar photovoltaic

One general rule for the "loading order" of improvements is to install all energy efficiency improvements prior to installation of any renewable systems. This reduces the overall demand on the solar pv or solar thermal system and, thus, the cost of the system.

6. HOW CAN A GREEN RETROFIT IMPROVE THE INDOOR AIR QUALITY (IAQ) AND HELP CREATE A HEALTHIER LIVING ENVIRONMENT FOR THE RESIDENTS?

The overall living environment can be improved for residents and staff by incorporating the following measures:

- Improved ventilation system to increase fresh air supply and distribution
- Installation of energy-efficient kitchen and bathroom fans that exhaust to the outdoors
- Sealing the building envelope to control moisture and pest intrusion
- Integrated Pest Management Program (IPM)
- Rubber walk off mats

The National Center for Healthy Housing has developed Seven Principles of Healthy Homes which include keeping a home:

- dry
- clean
- pest-free
- ventilated
- safe
- contaminant-free
- maintained

Link

▶ National Center for Healthy Housing Resource Library

7. WHAT QUALIFICATIONS SHOULD AN AUDITOR HAVE?

A multi-disciplinary team with multiple qualifications is usually required to complete all the necessary energy audit tasks. The chart below, adapted from the "*HERCC Audit Specifications Template for Multifamily Existing Buildings" (3.e)*, outlines energy audit tasks and suggests minimum qualifications.

Tasks	Qualifications
• Energy modeling and utility data analysis	• Certified Energy Plans Examiner (CEPE)
• Whole building energy audit and recommendations	• Building Performance Institute (BPI) • Multifamily Analyst, Certified Energy Manager (CEM)
• Combustion appliance safety	• BPI Building Analyst
• HVAC system efficiency and balancing (including duct testing)	• HVAC subcontractor, • Mechanical Engineer
• Central domestic water heating and Distribution system efficiency	• Plumbing or boiler contractor license • Mechanical Engineer
• Assess Building for water efficiency, resource Conservation and IAQ measures	• LEED AP • Mechanical Engineer
• Feasibility analysis of renewable energy systems	• State Solar Rebate Program approved licensed contractor, Mechanical Engineer, Electrical Engineer
• Analyze financial data and construction costs	• Construction Cost Estimator • Licensed General Contractor
• Energy audit and recommendations for non-residential spaces >20% floor area	• ASHRAE II auditor
• Commissioning and retro-commissioning	• Commissioning agent
• Operations and Maintenance	• BPI Multifamily Building Operator, National Affordable Housing Management Association (NAHMA) Green Building Operator, LEED EBOM

8. HOW MUCH DOES AN AUDIT COST?

A typical walk-through audit costs less than $5,000. ASHRAE Level II-III to Investment Grade Audits can range from $8,500 to $10,000.

- Factors that impact the total cost of an audit include:
- Size and number of buildings in the project
- Complexity of the space heating/cooling, ventilation and domestic hot water systems
- Scope of the required diagnostic testing
- Total number of units to be inspected–dependent on sampling required

9. HOW CAN I CREATE A PLAN TO RETROFIT MY WHOLE PORTFOLIO OVER TIME?

Owners can use a centralized database to adopt a thorough, in-depth, systematic approach to prioritizing and scheduling energy upgrades for all the buildings throughout an entire portfolio based on:

- Building vintage; completion dates for original construction and any rehabs
- Building type
- Equipment type and vintages
- Financing structure
- Solar exposure
- Rebate/incentive opportunities

Once these data are input for each building, the owner's team can determine which of the following upgrade approaches is appropriate for each building:

- Tune-up
- Prescriptive
- Whole-building

And based on the financing and rebate/incentives information input into the model, timing recommendations can be included.

Asset Management can integrate this retrofit assessment results into their overall capital needs planning. Plans to retrofit an entire portfolio or even multiple buildings allow owners to take advantage of economies of scale (e.g., bulk purchasing).

Link

- **Housing Partnership Networks (HPN) Group Buying Program**

10. WHAT METRIC CAN I USE TO COMPARE AND RANK MULTIPLE PROPERTIES IN A PORTFOLIO?

Once preliminary screening criteria have been used to identify retrofit candidates (refer FAQ #3), the metrics below can be calculated to provide more in-depth data on a specific property. These metrics also provide effective tools to compare and rank buildings.

Calculating a building's energy intensity is a valuable indicator of a single building's energy savings potential.

$$\text{Energy intensity} = \frac{\text{Energy consumption}}{\text{Floor area}}$$

Energy intensity can be expressed in:

- annual BTUs per square foot (BTUs/ft2)
- dollars per square foot
- kilowatt-hours/ft2 (kWh/ft2)

This information can be derived from historical utility bills. At a minimum, 12 consecutive months of data is required and 24 months is preferred.

A multifamily building using 80,000 BTUs/ft2 is probably an excellent candidate for energy efficiency improvements. Energy intensity of 25,000 BTUs/ft2 indicates a very efficient multifamily building.

The Home Heating Index (HHI) metric provides a means to compare buildings with different climates, energy prices and sizes. HHI is expressed in BTUs per square foot per heating-degree day (HDD)* (BTU/ft2/HDD). In hot climates where the cooling load predominates Home Cooling Index (HCI) is used.

Using these metrics to compare buildings within a portfolio can help identify the under-performing buildings, the "energy hogs".

*__Heating Degree Day__ (HDD): each degree that the average daily temperature is below the base temperature (usually 65 degrees) constitutes one heating degree day. As an example, a home in Duluth, Minnesota with 9,724 heating degree days annually requires twice as much fuel compared to an identical home in St. Louis, Missouri, with 4,758 heating degree days.

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Attachments

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The Scope of Work below includes recommended improvements to be made in Year 1.

An additional Excel version can be found at www.enterprisecommunity.org/retrofittoolkit

ECM	ECM DESCRIPTION	MEASURE INSTALLED COST ($)	ANNUAL COST SAVINGS ($) PAYBACK (YRS)	INDIVIDUAL MEASURE SIMPLE SIR	SAVINGS TO INVESTMENT RATIO	ANNUAL UTILITY SAVINGS				SITE BTUS SAVED PER $1,000 INVESTED	CARBON REDUCTION MTCO2/YR
						THERMS/$	KWH/$	GALLONS WATER/$	TOTAL UTILITY $ SAVINGS		
ENERGY WATER CONSERVATION MEASURES (EWCM)											
1											
2											
3											
4											
5											
6											
7											
8											
9	Improvement Package Totals										
EWCM Measure Total											
GREEN MEASURES (GM)											
GM Total											

ECM	ECM DESCRIPTION	MEASURE INSTALLED COST ($)	ANNUAL COST SAVINGS ($) PAYBACK (YRS)	INDIVIDUAL MEASURE SIMPLE SIR	SAVINGS TO INVESTMENT RATIO	ANNUAL UTILITY SAVINGS				SITE BTUS SAVED PER $1,000 INVESTED	CARBON REDUCTION MTCO2/YR
						THERMS/$	KWH/$	GALLONS WATER/$	TOTAL UTILITY $ SAVINGS		
PHYSICAL NEEDS											
Physical Needs Total											
CRITICAL REPAIRS *These items require immediate repair or replacement and may include health and safety conditions.*											
Site											
Mechanical Room											
Building Mechanical and Electrical											
Building Envelope											
Unit Interiors											
Critical Repairs Total											

ECM	ECM DESCRIPTION	MEASURE INSTALLED COST ($)	ANNUAL COST SAVINGS ($) PAYBACK (YRS)	INDIVIDUAL MEASURE SIMPLE SIR	SAVINGS TO INVESTMENT RATIO	ANNUAL UTILITY SAVINGS				SITE BTUS SAVED PER $1,000 INVESTED	CARBON REDUCTION MTCO2/YR
						THERMS/$	KWH/$	GALLONS WATER/$	TOTAL UTILITY $ SAVINGS		
NON-CRITICAL REPAIRS *These items require repair or replacement within a one year time frame.*											
Site											
Mechanical Room											
Building Mechanical and Electrical											
Building Envelope											
Unit Interiors											
Non-Critical Repairs Total											
RENEWABLE ENERGY											
Renewables Total											
TOTAL											

B ON-SITE VISIT GUIDELINES

AUDITOR CONDUCT STANDARDS

The Auditor shall comply with applicable professional standards for ethics as defined by the HERS Code of Ethics and/or Building Performance Institute Code of Ethics.

SCHEDULING THE SITE VISIT AND TENANT NOTIFICATION

The Auditor shall schedule the site visit(s) with the designated person(s) at a time that is convenient for the project contact person(s) and that will cause minimal disruption to the tenants and neighbors at the project.

Notification of tenants whose units will be inspected as part of the audit site visit will be the sole responsibility of property owner or their representative. Tenant language, safety, or behavioral issues should be addressed in coordination with the Owner or Property Manager.

SITE VISIT PREPARATION C

The auditor shall complete the site preparation tasks as described in **Site Visit Preparation** (*Attachment C*).

Review 24 months of prior utility bills (including gas, electric and water) to know annual utility consumption and cost by fuel type and seasonal variations. Analyze per building space usage (residential/common space/commercial).

Review as-built drawings (if available) and any other pertinent information about the site, and the building and its systems. Review any other PNAs or Energy Audits conducted on the building.

Analyze vacancy rates (current and past 24 months)

Obtain information on any changes to the building, its systems, and its occupancy over the past 24 months.

Review Operations & Maintenance, service calls and equipment servicing records over the last 24 months.

C I F

Note: The attachments referred to in this section can be found at **www.enterprisecommunity.org/retrofittoolkit**

ON-SITE VISIT GUIDELINES

SITE VISIT

- Project Interview(s). Auditor to interview at least one of the following designated person(s): Property Manager; Maintenance Director or maintenance staff; Owner or owner representative
- Purpose of the interview(s) is to: Discuss project energy and water performance; Discuss tenant comfort, health and safety and agree on a tenant synopsis for the site visit; Discuss operations and maintenance procedures; Discuss project mintenance concerns; Address any other stakeholder questions or concerns.
- Interview to include questioning on operations and maintenance issues and will address the issues including but not limited to those in Section D. If any project team member wishes their responses to remain confidential, the Auditor shall respect those requests.

Safety and Code Observations at the Site Visit.

- If, during the course of the site visit, the Auditor observes building code violation or a potential threat to health or safety, the Auditor shall immediately notify the designated person(s) in the project application and/or any individuals that are present representing the owner.

Visual Inspection and Diagnostic Testing Protocols

- The site visit shall involve visual inspections and **diagnostic testing** of the building envelope, HVAC, combustion safety, and lighting systems. All items listed in **Diagnostic Testing Guidelines (***Attachment I*), as applicable, will be performed during the site visits.
- Auditor shall identify and record **equipment specifications** listed on the form attached as **Equipment Specifications Worksheet (***Attachment F*). The equipment specifications will be used in the energy modeling and analysis phase of the audit.
- If Operating parameters of HVAC equipment or lighting system are not known to a high degree of confidence and are necessary for accurate energy cost savings analysis, the auditor may suggest short term monitoring of the systems to measure the actual operating conditions. The intent is to better inform the energy cost savings analysis. The Auditor must decide what is to be observed and measured and with what confidence and precision.

Dwelling Unit Sampling Protocols

- At least one in seven of every dwelling unit type (defined as having same/similar floor plan), with representation from differing building floors and location on floor (corner/middle and orientation) shall be inspected. In no case shall the inspection of units be less than 10% of total units. A larger sampling may be necessary depending upon funding source needs and other special circumstances.

Renewable Energy

- The on-site inspection will also examine, evaluate and propose recommendations for the incorporation of renewable energy opportunities, including but not limited to, photovoltaics and solar hot water. The solar thermal analysis to estimate the amount of DHW that can be potentially offset with a solar thermal system can be performed with the proprietary F-chart software or RetScreen. PV Watts is to be used to estimate the potential electricity offset by utilization of photovoltaic panels. Utilization of other calculation tools or approaches based on accepted engineering principles is acceptable but must be approved prior to use.

SITE VISIT PREPARATION

LOGISTICS	• Exchange cell numbers and email addresses with site contact person • Parking instructions/options • Intercom codes for entrance to facility
SELECTION OF SAMPLE UNITS	• Select sampling of units representative of unit types, conditions, sizes, and locations of no less than 10% units • Work with Green Retrofit Program to identify which commercial spaces will be inspected • Arrange access with residents through property representative
RESIDENT NOTIFICATION/ INVOLVEMENT	• Formal notification of residents regarding inspection • Formal notification of commercial space tenants • Select best approach to obtain resident input: individual interviews, resident representative/s, or small group
DEVELOPER	• Representatives from property management, O&M and resident services to attend kick-off meeting. • Staff person to accompany inspection team on visits to residents' units • Translator if needed to conduct interviews with residents O&M staff person who is most knowledgeable about the building and its service history available for interview

SITE VISIT PREPARATION

INFORMATION NEEDED AT SITE VISIT

- As-builts; one copy to review at the site (do not require a separate copy).
- Any specifications manuals
- Physical Needs Assessments conducted within the past 10 years
- Description and Costs (actual or estimates) of each retrofit, remodel, or improvements within the past 5 years
- Renewable energy feasibility assessments i.e. solar PV, HW
- All meter locations and areas they cover
- Operations & maintenance records/logs/protocols
- HVAC equipment and control systems information
- HVAC equipment repair records/log
- Pest management protocols and product information (MSDS sheets)
- Past 24 months of utility consumption and cost

ACCESS REQUIRED DURING SITE VISIT

- All mechanical rooms and all HVAC, domestic hot water, cogeneration equipment
- Elevator room/s
- Roof/s
- Sampling of residential units (see above)
- Recycling/waste disposal areas
- Electrical panel/s
- Basement
- Attic
- Commercial spaces
- Access to ladder appropriate to reach each of these spaces

D POTENTIAL OPERATIONS & MAINTANCE PROBLEM WORKSHEET

POTENTIAL OPERATIONS & MAINTANCE PROBLEM (to be discussed with O&M staff)	AFFECTED EQUIPMENT	DESCRIPTION (including duration, frequency, attempted fines)
○ Malfunctioning equipment: air conditioners, exhaust fans, ventilation system, pumps, chillers, boilers, etc		
○ Overheating motors, excessive motor cycling, etc		
○ Malfunctioning dampers or actuators		
○ Malfunctioning or commonly over-ridden thermostat programs		
○ Trouble maintaining hot water supply temperatures		
○ Leaky or faulty valves, pumps, pipe connections, etc		

☑ *Check when completed*

POTENTIAL OPERATIONS & MAINTANCE PROBLEM	AFFECTED EQUIPMENT	DESCRIPTION
○ Leaky hydronic coils		
○ Terminal units: noisy operation, inadequate air flow, or too much air flow		
○ Malfunctioning or commonly over-ridden thermostat programs		
○ Improper EMS controls programming, or not working as intended		
○ Inaccurate or faulty sensors, zone level thermostats, Improper sensor location		
○ Trouble maintaining supply air temperatures		
○ Excessive comfort complaints		
○ Malfunctioning lighting controls: occupancy sensors, sweeps, etc		

E INSPECTION WORKSHEET

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Building Zone Information	○ Determine # of levels, quantity of living units, location of common areas, and/or commercial space.	
	○ Measure floor areas in all residential, non-residential and commercial spaces.	
	○ Identify and record on plan set location of air and thermal bounderies.	
	○ Identify crawlspaces and determine if conditioned or not.	
	○ Determine if basement is unconditioned, directly conditioned, or indirectly conditioned.	
Natural Ventilation and Infiltration	○ Observe general building condition for impact on infiltration rates, i.e. thermal bypass in insulation, spaces under doors and next to windows, duct system.	
Roof Pitch and Attic Geometry	○ Determine roof pitch.	
	○ Measure the area of all ceiling surfaces and identify the ceiling as next to: attic, exposed beams or rafters, or finished framed ceiling.	

☑ *Check when completed*

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Ceiling / Framing Assembly Construction (Attics)	○ Determine R-value of ceiling insulation.	
	○ Determine type and spacing of framing.	
	○ Determine construction assembly.	
	○ Determine insulation quality quality ie coverage, compression.	
	○ Check for radiant barrier.	
	○ Check for and record location and size of attic bypasses.	
	○ Evaluate attic-side of ceiling assembly for moiature intrusion.	
Attic Ventilation	○ Determine free ventilation area.	
	○ Determine the % of ventilation area located high.	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Flat Roof Construction (roof deck above attic)	○ Determine solar reflectance/emissivity; check for radient barrier.	
	○ Determine roofing surface.	
	○ Determine above deck roof insulation.	
	○ Determine roof mass.	
	○ Determine depth of framing.	
	○ Determine below deck insulation.	
	○ Check insulation installation quality quality, ie compression, coverage.	
	○ Check ceiling framing.	
	○ Check for and record location of any air or thermal bypasses.	
	○ Examine for evidence of moisture intrusion.	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Non-attic Ceiling and Roof Construction	○ Determine surface area.	
	○ Determine orientation and tilt.	
	○ Determine the assembly u-factor.	
Exterior Walls	○ Determine whether walls border exterior space, attic, garage or crawl space.	
	○ Determine wall orientation.	
	○ Determine surface area of all walls exposed to unconditioned space.	
	○ Determine construction type.	
	○ Determine framing size for all framed walls exposed to unconditioned space.	
	○ Check insulation installation quality, ie coverage, compression.	
	○ Determine type and thickness of all mass walls.	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Exterior Walls	○ Check for installation of vapor barrier.	
	○ Check for and record location and size of any air or thermal bypasses.	
Basement Walls and Floors	○ Determine area of basement walls.	
	○ Determine insulation in walls and floor of conditioned basement or crawl space.	
	○ Evaluate continuity of air and thermal boundary between basement and living spaces.	
Raised Floors	○ Measure floor area over crawlspace.	
	○ Measure floor area over exterior space.	
	○ Measure floor area over unconditioned garage.	
	○ Determine floor insulation level and u-factor.	
	○ Check insulation installation quality.	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Raised Floors	○ Check for and record location and size of any air or thermal bypasses.	
	○ Evaluate for evidence of moisture intrusion.	
Slab-on-grade	○ Identify slab on grade foundation.	
	○ Determine perimeter of slab foundation.	
	○ Determine perimeter and interior areas that are exposed.	
	○ Determine if slab perimeter insulation exists and determine insulation depth and R-value.	
Doors	○ Determine construction type of doors.	
	○ Determine orientation of doors.	
	○ Determine surface area of doors.	
	○ Determine prescence and size of any ovrhangs above doors.	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Doors	○ Determine door U-factor.	
Fenestration Types and Areas	○ Determine area of windows by orientation and by presence and sizeof overhangs.	
	○ Determine window framing type.	
	○ Determine total area of window glazing characteristics including U factor and Solar Heat Gain Coefficient (SHGC) by orientation and presence of overhangs.	
Heating System Type	○ Determine areas that are served by each heating system.	
	○ Determine fuel(s) used for heating. Identify type(s) of equipment for heating, including efficiency.	
	○ Determine the location and condition of the distribution system(s) for heating.	
	○ Determine location and condition of control system(s) for heating.	
	○ Determine the thermostat set points and schedules for heating.	
	○ Evaluate heating system combustion efficiency by analyzing steady-state efficiency (SSE), CO2, stack temperature, etc.	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Cooling System Type	○ Determine areas that are being served by each colling system.	
	○ Determine fuel(s) used for cooling.	
	○ Determine the type of cooling system(s), including efficiecy.	
	○ Determine the location and condition of the distribution system(s) for cooling.	
	○ Determine the location and condition of control system(s) for cooling.	
	○ Determine the thermostat set points and schedules for cooling.	
	○ Determine the cooling equipment efficiency.	
	○ **Cooling Coil Airflow Testing –** *see diagnostics*	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Air Distribution Ducts Characteristics	○ Identify the type, location and condition of distribution system(s) used for the heating and cooling systems.	
	○ Determine the value of distribution system insulation.	
	○ Evaluate presence of disconnected or loose duct connections & constricted ductums, also ducts in contact with roof deck, ceiling assembly, wall assembly, floor assembly or ground.	
	○ **Duct Testing** - *see diagnostics*	
Mechanical Ventilation	○ Inspect for ventilation system obstructions.	
	○ Identify bath ventilation system type and configuration, distribution system and location, and central system .	
	○ Identify kitchen ventilation system type and configuration, distribution system and location, and central system.	
	○ Identify whole-unit ventilation system type and configuration, distribution system and location, and central system.	
	○ **Centralized Ventilation Testing** - *see diagnostics*	
	○ Roof Fans	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Hydronic Heating and Combined Hydronic Systems	○ Record heating and cooling set point temperatures and schedules for each representative zone.	
	○ Inspect piping of hydronic heating and DHW systems for presence and quality of insulation.	
Domestic Hot Water	○ Determine fuel(s) and equipment type(s).	
	○ Determine location(s) of storage tank(s).	
	○ Determine capacity of storage tank(s).	
	○ Determine the Energy Factor or thermal efficiency of the water heater(s).	
	○ Determine the water distribution piping location and insulation.	
	○ Determine recirculation control, recirculation pump horse-power and efficient rating.	
	○ Measure recalculating system pipe location, length, and insulation thickness.	
	○ **Central DHW System diagnostic testing**	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Domestic Hot Water	○ Examine water heating controls, settings, and schedule.	
Solar Hot Water Heating Systems	○ If there is a solar hot water heating system, determine type of system.	
	○ Determine system controls and schedule.	
	○ Determine efficiency of solar system.	
	○ Determine capacity of system.	
Interior Lighting	○ Determine fixture type, quantity, and location.	
	○ Determine lamp type, and quality of type, per fixture.	
	○ Determine lamp Wattage per type.	
Exterior Lighting	○ Determine fixture type, quantity, and location.	
	○ Determine lamp type, and quality of type, per fixture.	

BUILDING COMPONENT	INSPECTION PROTOCOL DESCRIPTION	NOTES
Exterior Lighting	○ Determine lamp Wattage per type.	
Combustion Safety	○ Is there a garage attached to the resedential space?	
	○ Is there combustion eqipment in the building? If so, is it located within the conditioned space?	
	○ **Combustion Efficiency Testing-** *see diagnostics*	
Elevators	○ Determine elevator type, age, and motor nameplate data.	
	○ Evaluate building for air and thermal bypasses adjacent to elevator shaft.	
Appliances	○ Record general condition, quality, and nameplate data for all major appliances including clothes washers/dryers, dishwashers, refrigerators, freezers.	
Water Fixtures	○ Determine flow-rates for indoor water fixtures.	
	○ Determine quantity and location of water fixture types.	

F EQUIPMENT SPECIFICATIONS WORKSHEET

HVAC		SYSTEM 1*	SYSTEM 2
Space Cooling	**Outside Unit**		
	Location		
	Type		
	Fuel Service		
	Manufacturer		
	Model #		
	Serial #		
	Manufactured date		
	Cooling capacity (kBtu/h or tons)		
	Cooling airflow (cfm)		
	Cooling efficiency		
	Quantity		
	Indoor Fan coil		
	Manufacturer		
	Model #		
	Serial #		
	Areas served by this system?		

**Identify representative system if units are individually heated or cooled*

EQUIPMENT SPECIFICATIONS WORKSHEET

HVAC		SYSTEM 1*	SYSTEM 2
Space Heating	Location		
	Type		
	Fuel source		
	Manufacturer		
	Model #		
	Seriel #		
	Manufactured date		
	Capacity		
	Quantity		
	Areas served		
WATER HEATING			
DHW	Location		
	Type		
	Fuel source		
	Manufacturer		
	Model #		
	Serial #		
	Manufactured date		
	Input rating (kBtu/h)		
	Recovery rate (gal/h)		
	Storage tank volume (gal)		
	Energy Factor		
	Thermal Efficiency (> 100 gal)		

**Identify representative system if units are individually heated or cooled*

EQUIPMENT SPECIFICATIONS WORKSHEET

WATER HEATING		SYSTEM 1*	SYSTEM 2
DHW	Quantity		
	Areas served by this system?		
Combined Hydronic Systems	Location		
	Pipe length		
	Pipe location		
	Pipe diameter		
	Pipe insulation		
	Serial #		
	Manufactured date		
	Heating capacity kBtuh		
	Heating airflow		
	Quantity		
	Areas served by this system?		
Boiler – Space Heating	Location		
	Type		
	Fuel source		
	Manufacturer		
	Model #		
	Serial #		
	Manufactured date		
	Heating capacity		
	Quantity		
	Areas served by this system?		

**Identify representative system if units are individually heated or cooled*

EQUIPMENT SPECIFICATIONS WORKSHEET

DEDICATED OUTSIDE AIR SYSTEMS (VENTILATION)		SYSTEM 1*	SYSTEM 2
Exhaust Fans	Type		
	Motor Horsepower		
	CFM		
	Control		
	Areas served by this system?		
	Circulation pump		
	Circulation pump control		
	Associated distribution system type		
	Duration and frequency of operation		

**Identify representative system if units are individually heated or cooled*

EQUIPMENT SPECIFICATIONS WORKSHEET

POOL / SPA HEATERS	SYSTEM 1*	SYSTEM 2
Type		
Fuel source		
Manufacturer		
Model #		
Serial #		
Manufactured date		
Input rating (kBtu/h)		
SOLAR THERMAL		
SOLAR PV		

APPLIANCES	DISHWASHER	REFRIGERATOR	WASHER	DRYER
Manufacturer				
Model #				
Serial #				
Type				
Fuel Type				
Quantity				
Location				
Efficiency Rating				

**Identify representative system if units are individually heated or cooled*

UTILITY RELEASE FORM

I, **Authorized Property Owner Representative/Customer Name**, grant _____ permission to access and assess **past, current, and 84-month future** energy/water billing and consumption information for ongoing tracking of energy and water usage.

Date _____

If Applicable–Residential Usage: In connection to this release, owner/developer agrees to collect utility release forms from 15% of residents to track actual utility data of a sample of homes.

Property Name	Organization Name		
Contact Name	Contact Title		
Contact Phone	Contact Email		
Address	City	State	Zip

UTILITY NAME	ACCOUNT NAME	ACCOUNT NUMBER	ACCOUNT LOGIN	ACCOUNT PASSWORD
Electricity				
Natural Gas				
Water Service				

The information obtained pursuant to the release shall be treated as confidential to the maximum extent permitted by law.

BENCHMARKING TOOLS

Incorporate a benchmarking tool into your process. While others also exist, the three tools listed below represent an excellent cross-section:

- **EPA Portfolio Manager [EPA]**
  Portfolio Manager is an interactive energy management tool that allows you to track and assess energy and water consumption across your entire portfolio of buildings in a secure online environment. Whether you own, manage, or hold properties for investment, Portfolio Manager can help you set investment priorities, identify under-performing buildings, verify efficiency improvements, and receive EPA recognition for superior energy performance.

- **EnergyScoreCards [BrightPower]**
  EnergyScoreCards helps you manage energy efficiency in multi-tenant buildings. This online energy management and benchmarking tool organizes energy and water usage data, supports financial planning for energy improvements, and tracks the progress and success of energy- and water-saving efforts.

- **WegoWise [New Ecology]**
  WegoWise is a simple, powerful way to understand the performance of your entire portfolio. The beautiful, intuitive visualizations will give you an entirely new level of understanding about your properties. WegoWise does all the advanced analysis in the background based on your buildings' physical characteristics and utility data (which is collected automatically). What you see are answers to some of the questions you really care about. You don't need to be an expert to get the most out of WegoWise; but if you are an expert, there are advanced tools to help you, too.

I DIAGNOSTIC TESTING GUIDELINES

DIAGNOSTIC TEST	DIAGNOSTIC TESTING DESCRIPTION*	SUGGESTED TESTING	REQUIRED EQUIPMENT
Blower Door (Building Envelope Tightness)	Perform a blower door test to measure air tightness between sampled units or floor/building to the exterior. Close all windows and doors and use blower door equipment to pressurize the test area to 50 Pascal's (CFM50). Once the test area is pressurized, using a smoke pencil and visual observations, the tester shall inspect all potential areas of infiltration to identify leaks in building envelope relative to the outside and adjacent units. Depending on whether or not the dwelling units are compartmentalized, and pending participation in other incentive programs that require blower door testing, blower door testing may be required using one of the following approaches: 1. an entire floor to measure leakage to exterior for that floor or 2. measure the leakage to outside and unit to unit leakage by sampling several dwelling units. Seal off all adjacent units and test leakage to exterior and unit to unit for sampled space.	Blower door testing may be required for smaller sized low-rise buildings when testing an entire floor is feasible, or to test-out air sealing measure effectiveness. Confirmation of blower door testing will be determined at the pre-audit meeting.	Blower door
Smoke pencil and Infrared Camera (Building Envelope Sealing)	Use smoke pencil and infrared cameras in conjunction with blower door testing as an approach to assessing building envelope sealing. This is an easy way to identify places with inadequate insulation and building sealing, identify areas of high heat transfer, and can also identify water intrusion for the prevention of mold and water damage. (1)	Building envelope tightness testing using a smoke pencil and/or infrared camera is required for all audited dwelling audits and conditioned common areas for all projects.	Smoke pencil, Infrared camera

**numbers in parenthesis refer to footnotes on page 36*

DIAGNOSTIC TEST	DIAGNOSTIC TESTING DESCRIPTION*	SUGGESTED TESTING	REQUIRED EQUIPMENT
Quality Insulation Installation	Inspect attic insulation for incomplete coverage and compression and determine insulation effective R-value. Inspect attic for thermal bypass, moisture migration, air movement through insulation. (6)	Insulation installation quality is a required diagnostic inspection and is to be completed on all projects.	Infrared camera
Central DHW / Hydronic Heating Systems	Components of the central DHW systems to be inspected for safety issues, and energy/water conservation include: • Aqua stat setting for tank temperature • Settings for delivered hot water (re-circulation Aqua stat or anti-scalding mixing valve) • Venting path and detection of vent gas spillage • Gas (natural gas or propane) leakage • Water leakage • Electrical connections and controls • Secure access to the controls, valves, and burners is secure • Combustibles on or around the gas appliance • Proper operation of the pressure/temperature relief valve • Presence of and quality of pipe insulation • Water outlet temperature at sampling of delivery points and compare to set point • Actual gpm of fixtures by sampling of delivery points • Supply temperature reset control strategy is operating as-designed, and if outdoor air reset control, confirm outdoor thermometer reading correctly. • On DHW systems serving multiple dwelling units, inspect for presence of recirculation pump controls and assess retrofit potential for demand and temperature modulation controls	All central DHW and central hydronic heating systems are required to be inspected and diagnosed. It may be necessary for a person specially trained in large hydronic systems to inspect complex systems serving large high-rise residential buildings.	

**numbers in parenthesis refer to footnotes on page 36*

DIAGNOSTIC TEST	DIAGNOSTIC TESTING DESCRIPTION*	SUGGESTED TESTING	REQUIRED EQUIPMENT
Centralized Ventilation Systems	Check to see if the ventilation system does the job as effectively as possible. • Measure the fan volume and verify flow direction • Measure fan power. • Verify the actual and intended schedule of operation. • Compare actual flow rates with minimum required flow rates according to ASHRAE 62.1 Standard • Inspect all dampers for obstructions • Inspect bearings, pulleys, motor housing, for wear and tear (3) • Inspect controls	Testing of all central ventilation systems is required.	Anemometer, duct blaster, flow hood, smoke pencil, power meter
Exhaust Fan Testing	Test operation of kitchen, bathroom shower exhaust fans to ensure they are operating using the following procedures: • Measure flow rates of bathroom exhaust fans and kitchen hood fans. • Use smoke pencil to verify correct airflow direction.	Testing of all exhaust fans in sampled dwelling units is required.	Fan flow meter, flow hood, smoke pencil
Combustion Analysis and CO Testing	In audited dwelling units, perform the following three combustion diagnostic tests on furnaces, space heaters, water heaters, or boilers, as applicable. CO testing of stoves is required; backdraft & spillage testing of stoves is not. • Standard and worst case draft/spillage testing. • Combustion efficiency analysis • Ambient carbon monoxide (CO) and flue-gas testing. As applicable, for audited dwelling units, every combustion appliance will also be checked for a safe flue pipe, chimney or vent, adequate combustion air and gas leaks. (4,5)	Perform combustion analysis and CO testing in all audited dwelling units, as applicable to equipment located in the dwelling unit. A post-installation safety inspection of all combustion appliances must be completed whenever changes to the building envelope and/or heating system are part of the work scope.	Digital combustion analyzer (w/ CO and O2), CO meter

numbers in parenthesis refer to footnotes on page 36

DIAGNOSTIC TEST	DIAGNOSTIC TESTING DESCRIPTION*	SUGGESTED TESTING	REQUIRED EQUIPMENT
Duct Leakage	Duct leakage tests measure the airtightness of forced air distribution systems. The ducts can be tested for leakage to outside, or total leakage the duct system is pressurized to 25 Pascal's relative to the outside using a duct blaster, and the loss is measured by precisely measuring the fan flow and duct pressure.. When used in conjunction with theatrical fog (smoke test) the location of the leaks can also be identified. New or replacement systems leakage: less than 6% of system fan airflow (24 cfm/ton). Component replacements leakage: Less than 15% of system fan airflow (60cfm per ton) or more than 60% reduction in leakage. (1,5,6)	Duct leakage testing is required in all sampled dwelling units that have ducted heating and/or cooling systems.	Duct blaster, static pressure probes
Cooling Coil Airflow	Measure airflow across the cooling coil of air conditioners and heat pumps to verify that the airflow is as-designed and providing sufficient ventilation to the space. Inadequate airflow can reduce the cooling capacity of the system, and can result in ice build-up on the cooling coil. Target rate: 350 cfm/ton of nominal cooling in every zonal control mode. 300 cfm/ton necessary for refrigerant charge test. As an alternate to measuring the flow with a fan flow meter, the temperature split approach can be used. (1,2,6)	This test can be performed at the same time as the duct leakage testing. This test should be conducted on existing units, and with the replacement or installation of space-conditioning components.	Fan flow meter and flow grid or flow hood, duct static pressure measurement probes
Air Handler Fan Watt Draw	Excessive fan watt draw can indicate high duct pressure drops caused by impediments in the ducts. This test determines the fan W/cfm of delivered air. Target of 0.58 or fewer watts per CFM of measured airflow. (1,2,6)	This test can be performed at the same time as the duct leakage testing since the total airflow is measured for each test. The air handler fan watt draw test should be conducted on existing units.	Power meter, fan flow meter, duct pressure measurement device

**numbers in parenthesis refer to footnotes on page 36*

DIAGNOSTIC TEST	DIAGNOSTIC TESTING DESCRIPTION*	SUGGESTED TESTING	REQUIRED EQUIPMENT
Refrigerant Charge	HVAC tune-up measure for split system air conditioners and heat pumps to ensure the system has the appropriate refrigerant charge. Improperly charged systems (either too much or too little refrigerant) can lead to inefficient operation and potential compressor failure. Utilizing a refrigerant pressure gauge system, run the A/C for at least fifteen minutes to ensure steady state operation, and measure the pressures of the discharge and suction lines of the system. The temperatures of these lines, in addition to other system dry-bulb and wet bulb temperatures, also need to be measured to assess actual refrigerant charge. (1,6)	This test should be conducted on existing units, and with the replacement or installation of space-conditioning components. The test can be performed on both packaged and split system air conditioners, and are typical used on systems ten tons and less which are the expected sizes for residential systems.	Refrigerant manifold testing system

**numbers in parenthesis refer to footnotes below*

Notes:

1. Section 3 of Title 24 Joint Reference Appendix RA 3

2. Residential 2008 ACM 3.11.6

3. BPI MF Analyst Professional Technical Standards Section 3.7 and 3.8. See also BPI Best Practices, Ventilation System Inspection Checklist

4. BPI MF Analyst Professional Technical Standards Section 4.14-4.20

5. Missouri Department of Natural Resources Weatherization Manual Section 3 Technical Standards

6. HERS (Home Energy Rating System) Technical Guide 2008

7. T24 refers to California's Title 24 Energy Requirements

J ENERGY & WATER ANALYSIS GUIDELINES

ENERGY MODELING SOFTWARE REQUIREMENTS

- Auditor shall use either TREAT or other software as required by lenders and/or funders.
- The "pre-audit meeting" will be used to confirm the energy modeling software to be used for the subject audit report.
  The modeling software shall use hourly heating and cooling load calculations based on ASHRAE fundamentals (BPI 3.5. [include link]
- To maintain connection with weatherization programs and other subsidy programs, the Auditor must use energy modeling software or other utility analysis that complies with the project's local weatherization or other subsidy program requirements.
- Permission required prior to utilizing other energy modeling software.

BENCHMARKING ▶ Follow **Portfolio Manager Protocol**

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.

ENERGY EFFICIENCY MEASURE ALTERNATIVES

The analysis and report should include several alternatives that include a group of specific energy efficiency measures that have been analyzed and are suggested for implementation. Potential alternatives may include weatherization measures as opposed to replacing windows and doors. Retro-commissioning of boiler systems instead of replacing the boiler is another potential alternative if the equipment still has a reasonable expected useful life (EUL). The energy savings for all measures analyzed should still be presented in the report to show their impact, and those not suggested for implementation are to be excluded from the combined alternative package of suggested measures.

EQUIPMENT SIZING

(*Excerpted from the Fannie Mae Green Refinance Plus Green PNA Statement of Work and Contractor Qualifications*)

- **HVAC equipment.** Auditor must evidence that the Air Conditioning Contractors of America (ACCA) Manual J guide or other industry-wide accepted methodology was used to size the recommended heating and cooling systems. There are 2 exceptions to this requirement to complete a load calculation to appropriately size the heating and cooling systems:

- When the existing units are already the smallest available and there are no known property management or tenant complaints indicating that the existing systems may be inadequate. To justify this exception, the Auditor must inquire of the site property management and of any tenants encountered during the inspection of the units, and not receive comments that would cause the Auditor to questions the adequacy of the existing systems.

- When the existing units use electric baseboard heat and conversion to another heating system has been determined to be infeasible. To justify this exception, the Auditor must consider any comments about unit heating received from inquiring of the site property management and of any tenants encountered during the inspection of units and state why conversion to another source is infeasible.

- **Domestic Hot Water Heaters:** The auditor must evidence that they have analyzed the size of the existing hot water heaters/boilers and analyzed the appropriate efficient replacement size using First Hour Rating (primarily for individual resident hot water heaters) or other professionally recognized sizing tool with a goal of providing sufficient but not excess capacity

EXISTING DUCTWORK

The Auditor must evidence that they have inspected the ductwork for leakage and recommended and price appropriate repairs. The objective is to indentify energy-saving opportunities and the Auditor's professional judgment is being relied on as to the extent of any inspection, testing, cleaning and repair that is warranted for the specific property. If the ducts are accessible, the Auditor is to conduct a visual inspection and make recommendations for the repair of any loose/broken connections or other leaks. If the ducts are not accessible, the Auditor is to provide an opinion on the likely cost-benefit analysis of repairing the ducts and the approach recommended to do so (including the use of a aerosol-based product)

UTILITY RATES

The energy consultant shall model the building using the current local utility rate schedules as verified during review of utility bills. The local utility rate may have to be created in the energy modeling software. Energy cost savings calculated outside of the modeling software shall be based on actual utility rates used by the building. An average or "blended" utility rate, accounting for monthly service and time-of-use charges, shall not be used to calculate energy cost savings if possible.

MODEL CALIBRATION

The energy model for buildings that are mastered metered shall be calibrated to actual utility billing data. Modeled baseline energy consumption shall be calibrated to monthly utility bills for a minimum of twelve months. The intent is to establish the modeling results verified for consistency and accuracy.

- The energy model estimates of electricity and natural gas should calibrate to actual monthly consumption to within 10%.
- TMY 30 year average weather data can be used in lieu of actual year weather, which may be difficult to obtain.
- Any adjustments made to the building description inputs used to calibrate the simulated building to actual energy usage must be justified with explicit, transparent information and documented in this section of the audit report.

EXCEPTIONAL CALCULATIONS

Energy conservation measures not directly modeled with the energy modeling software can be calculated outside of the program provided that generally accepted engineering calculations and methodologies are used. Interactive effects must be accounted for in exceptional calculations. The methodologies, assumptions, and constants used in the exceptional calculations must be clearly documented in the final report. Sources of deemed savings must be referenced.

SAMPLING FOR ENERGY ANALYSIS

If the project is comprised of multiple buildings, the whole building-simulation shall include at least one example of each building type. If units are individually metered and billed, the Auditor, the Contractor must request 12 months of whole building consumption data from each utility company on the Owner's behalf. In cases where whole building data is not available directly from the utility, the Contractor must request a release form from the local utilities and the property's management agent will gather two months of utility bills from tenants and deliver to the Contractor.

SAVINGS TO INVESTMENT RATIO OF EACH MEASURE

As of this writing, the SIR is to be calculated by dividing the savings per year by the payment amount (taking into account the discount rate and estimated useful life of the equipment) divided by the cost of the measure. Using Microsoft Excel this equation is expressed as:

- **SIR= Savings per year ($)**
- **Divided by PMT (3% discount rate, Estimated Useful Life, -1)**
- **Divided by Measure Cost ($)**

**Estimated Useful Life for recommended measures is to be derived using the EUL values used in the Database for Energy Efficiency Resources (DEER) database used by CA utilities for energy efficiency retrofits and for weatherization purposes shall not be greater than 20 years for a given measure.*

K ENERGY MODELING REPORTING REQUIREMENTS

ENERGY AND WATER ANALYSIS METHODOLOGY

This section of the report should summarize the energy modeling approach and other calculation methods used in the energy and water analysis. Include name and version of energy modeling software used and indicate if exceptional calculations are used to estimate energy and energy cost savings. Provide a summary of the approach, and detailed calculations, used in any exceptional calculations used for analysis.

UTILITY ANALYSIS AND END USE BREAKDOWN

This section shall describe the applicable end use(s) for each type of fuel at the project and present a visual breakdown of annual energy and energy cost by fuel type:

- The Auditor shall graph energy usage for each fuel type for a minimum of 12 months
- The Auditor shall review the utility rate structure to determine if it seems appropriate for the project
- The Auditor shall make a recommendation for further investigation if the Auditor finds that the rate structure does not match the utility data

SOURCE OF INFORMATION

This section briefly describes all sources of information used to inform the analysis including:

- The source and scope of utility billing data supplied to the Auditor including the data source, the data duration in months over which the data covers, and whether the
- Auditor received copies of the actual utility bills or electronic interval data.
- Construction cost information used in economic analysis
- Report if building plans or site verified data was used in the analysis
- Report any discrepancies between plans and verified conditions.
- Utility rate and schedules
- Source of deemed energy savings

ENERGY MODELING REPORTING REQUIREMENTS

ENERGY MODEL INPUTS AND ASSUMPTIONS L

The audit shall clearly state any assumptions used when analyzing energy and water utility data. The report shall include an **Energy Model Input Assumptions Table** (*Attachment L*) which reports an overview of all model inputs for both the baseline case and the proposed case energy models. This table should also highlight building components that were analyzed as potential energy conservation measures and those having greatest impact on final energy cost savings estimates. The **Input Assumptions Table** will be in the form of *Attachment L*.

ENERGY MODEL DOCUMENTATION

Provide final energy model input and output files used to report energy and energy cost. A log of all final justified adjustments made to the energy model during the calibration process must also be submitted in the final report.

L ENERGY MODELING INPUT ASSUMPTIONS TABLE

GENERAL	**Occupied Square Footage**	SF:
	Resident Population	Persons:
UTILITY METERING	Common Space:	Utility: ○ Master ○ Individual
	Whole Building:	Utility: ○ Master ○ Individual
	Whole Building:	Utility: ○ Master ○ Individual
	Units:	Utility: ○ Master ○ Individual
	Space:	Utility: ○ Master ○ Individual
BUILDING ENVELOPE	**Wall Insulation**	Type: R-Value:
	Exterior Doors 1	Type: R-Value:
	Exterior Doors 2	Type: R-Value:
	Windows 1	Type: R-Value:
	Windows 2	Type: R-Value:
	Roof Insulation	Type: R-Value:
	Floor	Type: R-Value:
	Slab	Type: R-Value:
INFILTRATION	**Infiltration Condition**	○ Tight ○ Leaky ○ Very Leaky
	Infiltration Rate	Air Changes/Hour (ACH):
DISTRIBUTION SYSTEMS	**Hydronic heat**	Type/location:
	Hydronic heat/chilled water	Type/location:
	Low pressure steam	Type/location:
	Force air (warm and/or chilled)	Type/location:

ENERGY & WATER AUDIT MODELING TABLE

HEATING / COOLING CONTROLS	**System Type**	◯ Central ◯ Individual
	Heating Controls Type	◯ TRV ◯ Dial ◯ Programmable
	Heating Occupied Set Point	Temperature (Degrees F):
	Cooling Occupied Set Point	Temperature (Degrees F):
	Programmable Setback	Temperature (Degrees F):
	Programmable Setback Time	Hours/Day:
SPACE AND WATER HEATING	**Boilers (Hydronic)**	Type:
		Combustion Efficiency:
	Boilers (Steam)	Type:
		Combustion Efficiency:
	DHW Tanks	Type:
		Combustion Efficiency:
	Tankless Coils	Type:
		Efficiency:
	Other	Type:
		Efficiency:
EXHAUST FANS / MECHANICAL VENTILATION	**Bathroom exhaust fans**	CFM per Fan:
	Kitchen exhaust fans (ducted)	CFM per Fan:
	Control	Type:

ENERGY & WATER AUDIT MODELING TABLE

DOMESTIC HOT WATER	**Daily Usage/Resident**		Gallons/Day:	
	Delivery Temperature		Temperature (Degrees F):	
	Return Temperature		Temperature (Degrees F):	
	Pipe Insulation		R-Value:	
	Shower Heads		Gallons per Minute (GPM):	
	Sinks		Aerators: ◯ Yes ◯ No	
DOMESTIC COLD WATER	**Toilets, Common**		GPF:	Flushes per Day:
	Toilets, Dwelling Units		GPF:	Flushes per Day:
LIGHTING	**Space**	Type:	Wattage:	Usage:
	Space	Type:	Wattage:	Usage:
	Space	Type:	Wattage:	Usage:
	Space	Type:	Wattage:	Usage:
	Space	Type:	Wattage:	Usage:
	Space	Type:	Wattage:	Usage:
	Space	Type:	Wattage:	Usage:
APPLIANCES	**Refrigerator**		Energy Star: ◯ Yes ◯ No	
			Usage per Year:	
	Dishwashing		Energy Star: ◯ Yes ◯ No	
			Usage per Year:	
	Laundry		Energy Star: ◯ Yes ◯ No	
			Usage per Year:	
	Miscellaneous Plug Loads		Energy Star: ◯ Yes ◯ No	
			Usage per Year:	

INTEGRATED PEST MANAGEMENT GUIDELINES

The following information is taken from Part 3 of the Fannie Mae "Green Refinance Plus: Green Physical Needs Assessment Statement of Work and Contractor Qualifications"

QUALIFICATIONS

The Contractor completing the Integrated Pest Management Inspection (IPMI) must:

- Be certified by QualityPro Green, GreenShield or EcoWise
- Be trained to evaluate and treat the interior and exterior of multifamily structures for pest infestations, in accordance with Integrated Pest Management (IPM) standards
- Have the work performed by an employee who is licensed or certified by the state for residential pest control or be QualityPro Green certified and who has produced reports of this nature that are well regarded in the marketplace in terms of content, timeliness and responsiveness
- Not to be under suspension or debarment by HUD or Fannie Mae, or involved as a defendant in criminal or civil action with HUD or Fannie Mae
- Have the capacity to complete the project inspection and prepare the report in an acceptable time frame

STATEMENT OF WORK

The Contractor shall:

- Perform an IPMI, provide the property manager and each with information on glue traps and prepare an IPMI report for each asset specified by the Lender/s and report the findings.
- NOTE: The following instructions assume the Contractor will make two site visits to the property: Interviewing property management about existing pest control practices and placing the glue traps during the first visit, retrieving the glue traps and conducting the necessary unit and property inspections during the second visit. The Lender has the authority to modify the instructions to require only one visit by the Contractor in those situations where the Lender believes the onsite property management can place the glue traps correctly and provide the glue trap handout to the tenants.

Conduct the first onsite visit/inspection to:

- Obtain an understanding of the configuration of the buildings
- Obtain an understanding of the existing pest control practices
- Review the "Using the Glue Traps" handout with the property manager ad provide it to each tenant or leave it in each unit where glue traps are placed. Handout is available on **www.oahp.net**
- Place the glue traps to assess the cockroach infestation within each unit and common areas such as laundry rooms, storage rooms and interior trash handling areas
- Advise the property manager that the Contractor will retrieve the glue traps and set a date certain for that follow-up visit/inspection

Conduct the second onsite visit/inspection to:

- Collect the glue traps from each unit, observe conditions in the units and include a unit-by-unit summary of the glue trap findings in the report
- Review the findings from the glue traps to help determine which units should be inspected. The Contractor shall conduct site inspections of a minimum of 10% of all units. Unless otherwise guided by the glue trap findings, units shall be randomly sampled while taking into consideration occupied and unoccupied units and the unit size mix i.e. one-bedroom, two-bedrooms, etc. If a significant number of the units are found to have infestations not reflected in the glue trap findings, the Lender may require that additional units be inspected at the time the glue traps are collected.
- Inspect the exterior of building(s) for evidence of pest infestation or conditions which could attract and/or harbor pests. Inspect and identify all areas where the enveloper has been penetrated and all points of ingress/egress, looking for any entry points for pests. If identified, the Contractor must determine and document all corrective measures, both immediate and long-term.
- Inspect the trash disposal, laundry, common areas, office space, maintenance work area and storage areas for evidence of infestations.

Prepare a narrative report that:

- Identifies any pest infestations based on the results of the glue trap findings, a visual survey, a review of any pertinent documentation related to past infestations and pest control measures, and/or interviews with the property owner, management staff and tenants

- Includes color photographs and a detailed narrative describing the property's pest infestation, if any, and provides a corrective course of action for each infestation and if needed, specific actions for serious infestations within individual units
- Includes a Glue Trap Summary which identifies in detail the quantity and variety of pests trapped and any obvious general areas/floors/structures with significant infestations (e.g., if a cluster of adjacent apartments appear to have a more severe infestation when compared to the overall building). Identify groups of infested units as High, Moderate or Low infestation and detail corrective measures for each.
- Details an immediate course of action, being specific as to physical items needed (e.g. door sweeps) and treatments needed, if any, and the estimated costs to address the pest infestations for each identified group (see prior paragraph) and a continuing course of action for using IPM principles at the property

Prepare a report regarding existing pest control practices that:

- Documents the existing pest control strategies, practices and outcomes
- Evaluates the existing pest control strategies and practices
- Identifies the deficiencies in the existing pest control strategies and practices
- Recommends practices consistent with IPM principles that will achieve better outcomes

The IPMI part of the GPNA should include the following subcomponents:

- Acknowledgements (who conducted the inspection and prepared the reports, the preparer's qualifications or a certification that the preparer meets the qualifications required in Section 1 (see above), when the report was prepared, who received the report and when the report was reviewed
- Appendices (color photographs, site plans, maps, etc)
- If the services of a subcontractor were secured to inspect the property and complete the report, the Contractor shall review the inspection for quality, consistency and agreed upon format and conformance with these requirements

DELIVERABLES

The report and completed exhibits will be incorporated into the overall Green CNA deliverables submitted by the Contractor.

QUALITY ASSURANCE & VERIFICATION GUIDELINES BY MEASURE

EFFICIENCY MEASURE PROCEDURE	QUALITY ASSURANCE & VERIFICATION IS REQUIRED FOR ALL IMPROVEMENTS	DOCUMENTATION PHOTO DOCUMENTATION FOR QA&V AND ROLE	OTHER PARTICIPANTS
Envelope	○ RRequire contractor to do a mock-up of wall and window assembly, including all related trades i.e. sheet metal for review/approval prior to installing all windows ○ Field inspection by manufacturer representative ○ Photos ○ Visual Inspection ○ Blower door test-in and test-out ○ Conduct blower door and smoke pencil tests on sampling ○ Infrared camera imaging	Obtain product technical data including: • # of windows • configuration by size and style • Area orientation for each window configuration • NFRC rating of each configuration • Manufacturer name, window series and model # • Contractor installation warranty (if applicable) • *Other items to document:* Photos, infrared images, report on smoke pencil test results, manufacturer rep field report	window manufacturer rep, Contractor/installer
Replace roofing and install R-38 insulation	○ On-site inspection roofing manufacturer representative ○ HERS rater inspection for insulation installation	• Roofing manufacturer's on-site inspection report • Insulation installer certificate • HERS rater inspection/report	roofing, insulation subcontractors
Window weatherstripping/ control air leakage	○ Visual inspection ○ Use infrared camera, smoke pencil to help identify direct or indirect (internal) air leakage *These test-outs to be performed on 15% of units including a mix of those located at upper/lower floors and all orientations. Per ASHRAE Standard 62-1989 air leakage or a combination of air leakage and mechanical ventilation must provide at least 15 CFM per person or 0.35 air changes per hour, whichever is greater.*	• Photos, infrared camera photos and blower door test-in and test-out results. All documentation to show pre- and post-improvement conditions.	

✓ *Check when completed*

EFFICIENCY MEASURE PROCEDURE	QUALITY ASSURANCE & VERIFICATION IS REQUIRED FOR ALL IMPROVEMENTS	DOCUMENTATION PHOTO DOCUMENTATION FOR QA&V AND ROLE	OTHER PARTICIPANTS
DHW Tune-up (E) gas fire DHW	○ Record hot water temperature at sink and tub/ shower in 10% of the units ○ Measure supply and return water temperature ○ Test combustion efficiency	• Log of recorded temperature at sampled fixtures and at DHW • Results of combustion efficiency test	
Insulate hot water piping	○ Visual inspection ○ Photos	• Photos	
Insulate hot water tanks	○ Visual inspection ○ Photos	• Photos	
Low-flow fixture replacement	○ Visual inspection of installed fixture in all units ○ GPM Flow rate samplings to be conducted at all fixtures in 10% of the units	• Photo • Product technical data sheets	
Replace DHW Pumps (VFD)	○ Visual inspection ○ Follow protocol in VFD Prefunctional Checklist referred to in Documentation ○ Conduct Functional VFD and Pump tests listed in Documentation	• Equipment manuals • Photos • (C.VFD 1)–VFD Pre-Functional Checklist completed • (C.VFD 2)–Functional Test VFD Seattle City Light form filled in • D. Heating Cooling Water Pumps • Hot Water System Pump Functional Test documentation	Testing performed by plumbing, boiler subcontractor/installer

Install Domestic Hot Water Heater	○ Visual inspection
	○ Obtain product technical data
	○ Complete Pre-Functional Checklist described in Documentation
	○ Conduct Functional Test listed in Documentation
		• Obtain Product technical data including:
		  • Equipment, manufacturer and model number
		  • Equipment capacities and efficiency ratings
		  • Total quantity installed
		  • Installation location
		  • Date of installation
		  • Contact info of contractor/installer
		• Equipment manual
		• Photos
		• (B. Boiler 1) Boiler Prefunctional checklist filled out
		• (B. Boiler 2) Functional test Boilers form completed
			testing performed by plumbing, boiler subcontractor/installer

EFFICIENCY MEASURE PROCEDURE	QUALITY ASSURANCE & VERIFICATION IS REQUIRED FOR ALL IMPROVEMENTS	DOCUMENTATION PHOTO DOCUMENTATION FOR QA&V AND ROLE	OTHER PARTICIPANTS
DHW Install Solar Hot Water Heating	○ Visual inspection ○ Conduct Inspection per the Checklist and Protocol listed in Documentation	• Photos • Equipment manual • (E. Solar Thermal 1) CSI Solar Thermal Inspection Checklist completed	testing performed by solar installer
HVAC Programmable thermostats	○ Visual inspection ○ Obtain/review equipment manuals ○ Ensure thermostats are programmed per auditor recommendations in a sampling of the units	• Log confirming programmed temperatures in a sampling of the units	
Install outside Air (OA) Temp controls for boiler	○ Monitor boiler activity in response to change in OA temperature ○ Conduct Functional Test listed in Documentation	• Log of boiler response to change in OA t emperature • (B. Boiler 2) Functional Test Boiler System	testing performed by plumbing, boiler subcontractor/installer & manufacturer rep
Install VFD on Heating/ cooling	○ Visual inspection ○ Follow protocol in VFD Prefunctional Test listed in documentation ○ Conduct VFD Functional Test in documentation	• Photos • Equipment manual (C. VFD 1) VFD Pre-functional Checklist form completed • (C. VFD 2) VFD Functional Test form completed	testing performed by subcontractor/installer
Thermostatic Radiator Valve (TRV) & cleaning	○ Visual inspection in a sampling of the units	• Pre- and post-improvement photos • Product technical data	subcontractor
Tune-up (E) space heating boiler	○ Measure supply and return water temp ○ Test combustion efficiency	• Log of recorded temperatures supply and return • Results of combustion efficiency test	subcontractor and manufacturer rep
Replace exhaust fan motors with more efficient ones	○ Visual inspection ○ Smoke test ○ Use flow hood to measure exhaust airflow ○ Test air quality in subject area moisture, CO content ○ May require testing and balancing if it's a balanced ventilation/exhaust system	• Equipment manuals • Photos • Flow hood test results data • Documentation of air quality • TAB report if applicable	

EFFICIENCY MEASURE PROCEDURE	QUALITY ASSURANCE & VERIFICATION IS REQUIRED FOR ALL IMPROVEMENTS	DOCUMENTATION PHOTO DOCUMENTATION FOR QA&V AND ROLE	OTHER PARTICIPANTS
HVAC Add timers to Laundry Rm exhaust fans	○ Visual inspection ○ Check to see if timers operate correctly ○ Test air quality in subject area moisture, CO content	• Photos • Equipment manual • Documentation of air quality	
Install VFDs, CO Sens, EMS and control all Parking Garage Exhaust Fan Motors	○ Visual inspection ○ Follow protocol in VFD Prefunctional Checklist ○ Conduct VFD Functional Test ○ Test EMS controls ○ Test air quality, CO content	• EMS controls test results • Air quality, CO content test results • (C.VFD 1) VFD Functional Test form completed • (C.VFD 2) VFD Functional Test report form completed • Report on EMS Controls • Air testing results	
Replace wall furnaces with heat pump system	○ Conduct Prefunctional Checklist review listed in Documentation ○ Perform Functional Test listed in Documentation	• Photos • Equipment manual • (A. Heat Pump 1) Prefunctional Checklist completed • (A. Heat Pump 2) 1019 Small Packaged Rooftop DXFunctional Test form completed	subcontractor
Install High Efficiency Heat Pumps	○ Conduct Prefunctional Checklist review listed in Documentation ○ Perform Functional Test listed in Documentation	• Photos • Equipment manual • (A. Heat Pump 1) Prefunctional Checklist completed • (A. Heat Pump 2) 1019 Small Packaged Rooftop DXFunctional Test form completed	subcontractor
Steam/Space htg Boiler Replacement	○ Follow protocol listed Prefunctional Checklist referred to in Documentation ○ Conduct Boiler System Functional Tests referred to in Documentation	• Photos • Equipment manuals • (B. Boiler 1) Boiler Prefunctional Checklist form completed • (B. Boiler 2) Boiler Functional Test form completed • Water or room temperature tests in a sampling of units	subcontractor, Manufacturer rep inspection

EFFICIENCY MEASURE PROCEDURE	QUALITY ASSURANCE & VERIFICATION IS REQUIRED FOR ALL IMPROVEMENTS	DOCUMENTATION PHOTO DOCUMENTATION FOR QA&V AND ROLE	OTHER PARTICIPANTS
HVAC Replace thru-wall AC/Elect heat with Energy Star heat pumps	○ Conduct Prefunctional Checklist review listed in Documentation ○ Perform Functional Test listed in Documentation	• Photos • Equipment manual • (A. Heat Pump 1) Prefunctional Checklist completed • (A. Heat Pump 2) 1019 Small Packaged Rooftop DXFunctional Test form completed	subcontractor
Replace window AC w/ Energy star	○ Visual inspection ○ Verify that AC units work in all units	• Photos • Equipment manual	
Lighting/Exit Signs Lighting	○ Visual inspection ○ Collect technical product data (see documentation)	Obtain Product technical data including: • Location, type, quantity of pre- and post- retrofit lighting fixtures • Lamp manufacturer and model number • Lamp wattage and quantity per fixture • Ballast type, manufacturer, model number and quantity per fixture type • Date of installation • Name, address and contact info for installer/ contractor	subcontractor and manufacturer rep
Lighting controls	○ Confirm all controls have been properly located, field calibrated and set for correct set points and threshold light levels ○ Obtain documentation of setpoints, settings and programming for each device from installer ○ Simulate daylight conditions to verify dimming of the controlled lights and simulate lack of daylight to verify energizing of the light fixtures	• Documentation of setpoints, settings and programming for each device from installer • Report confirming controls perform as designed	subcontractor and manufacturer rep

EFFICIENCY MEASURE PROCEDURE	QUALITY ASSURANCE & VERIFICATION IS REQUIRED FOR ALL IMPROVEMENTS	DOCUMENTATION PHOTO DOCUMENTATION FOR QA&V AND ROLE	OTHER PARTICIPANTS
Lighting/Exit Signs Replace Hi intensity Discharge Lamp with Induction lighting	○ Visual inspection, collect technical product data (see documentation)	Obtain Product technical data including: • Location, type, quantity of pre- and post- retrofit lighting fixtures • Lamp manufacturer and model number • Lamp wattage and quantity per fixture • Date of installation • Name, address and contact info for installer/ contractor	subcontractor and manufacturer rep
Exit fixtures with LED fixtures	○ Visual inspection ○ Collect technical product data (see documentation)	Obtain Product technical data including: • Location, type, quantity of pre- and post- retrofit lighting fixtures • Fixture manufacturer and model number • Fixture wattage and quantity per fixture • Date of installation • Name, address and contact info for installer/ contractor	subcontractor
Appliances Energy Star Appliance Replacement	○ Verify installation of 15% of unit and 100% of common area appliances, and check invoices to confirm equipment purchase for entire building ○ Take photos ○ Obtain technical specs	• Photos • Equipment manuals	
Energy Star washing machine replacement	○ Verify installation of 15% of unit and 100% of common area appliances, and check invoices to confirm equipment purchase for entire building ○ Take photos ○ Obtain technical specs	• Photos • Equipment manuals	
Add Vend Mizers to Vend mach, Cold water fountain	○ Verify installation of all units ○ Take photos ○ Obtain technical specs	• Photos • Equipment manuals	

EFFICIENCY MEASURE PROCEDURE	QUALITY ASSURANCE & VERIFICATION IS REQUIRED FOR ALL IMPROVEMENTS	DOCUMENTATION PHOTO DOCUMENTATION FOR QA&V AND ROLE	OTHER PARTICIPANTS
Elevator Replace elevator motors with efficient ones	○ Obtain equipment manual, technical specs from vendor	• Photos • Equipment manuals • Results of test-out by elevator contractor	subcontractor, manufacturer rep, City/County/ State Elevator Inspector
Renewables Solar Photovoltaic	○ Visual inspection ○ Conduct Inspection per the Checklist and Protocol listed in Documentation	• Photos • Equipment manual • (F. Solar PV 1) CSI Inspection Protocol completed and documented	testing performed by installer

Notes:

1. Representative sampling unless otherwise noted shall include all of the subject fixtures/installations in 10% of the units but not less than 4 units. Selected units shall represent a mix of units from upper/lower floors and various orientations.

2. If sampling is not called out, assume all improvements must be inspected in all units.

3. Prefunctional checklists and Functional test document designations A-E and 1-2 refer back to the "QA&V List of Documents 6-1-11".

4. Prefunctional and Functional test forms can be found at the PECI (Portland Energy Conservatory Inc.) website at: http://www.peci.org/ftguide/index.htm

FINANCIAL DECISION TREE

Affordable (Property-specific)

TAX CREDIT

STAND ALONE

Grants/Equity
- Foundation Grants
- Utility Rebates/Incentives
- Weatherization (WAP)
- Reserves

Loans-intermediaries, Utilities
- Enterprise/LIIF
- Foundation PRI
- On-bill financing

Loans-Government
- FHA 241(f) for properties with HUD-insured mortages
  - Size/term based on savings and payback
- Local jurisdictional funds
  - American Recovery and Reinvestment Act (ARRA)
  - Energy Efficiency Community Block Grant
  - Community Development Block Grant
  - Redevelopment Agencies

Individually-Metered
- Solar PV (net metering)
  - Local Utility Rebates
  - Power Purchase Agreement
- Energy Eff Based Utility Allowance (EEBUA)

Master-Metered
- Solar PV
  - Local Utility Rebates
  - Power Purchase Agreement
- Solar-Thermal
  - Local Utility Rebates

REFI/RESYNICATION

Equity
- LIHTC–9% Or 4%
- Federal Tax Credits

Loans-intermediaries, Utilities
- CDFI
- Foundation PRI
- On-bill financing

Loans-Government
- First mortage
  - EE savings factor into underwriting
- FHA 223(f) new loan sized to include retrofit costs
  - American Recovery and Reinvestment Act (ARRA)
  - Energy Efficiency Community Block Grant
  - Community Development Block Grant
  - Redevelopment Agencies

Individually-Metered
- Solar PV (net metering)
  - Local Utility Rebates
  - Power Purchase Agreement
- Energy Eff Based Utility Allowance (EEBUA)

Master-Metered
- Solar PV
  - Power Purchase Agreement
- Solar-Thermal
  - Local Utility Rebates

Market (Property-specific)

AFFORDABLE–NO LIHTC

STAND ALONE

Loans
- Personal Guarantee
- Other Collateral
- On-bill financing

Loans to Property
- Line of Credit, second mortage

Individually-Metered
- Solar PV (net metering)
  - Federal Energy Tax Credits
  - Power Purchase Agreement
  - Rent increase/green lease

Master-Metered
- Rent increase/green marketing

REFINANCE

Loans–Secured
- Energy-efficient mortage (sized to factor in EE savings)
- Line of Credit, second mortage

Individually-Metered
- Solar PV (net metering)
  - Federal Energy Tax Credits
  - Power Purchase Agreement

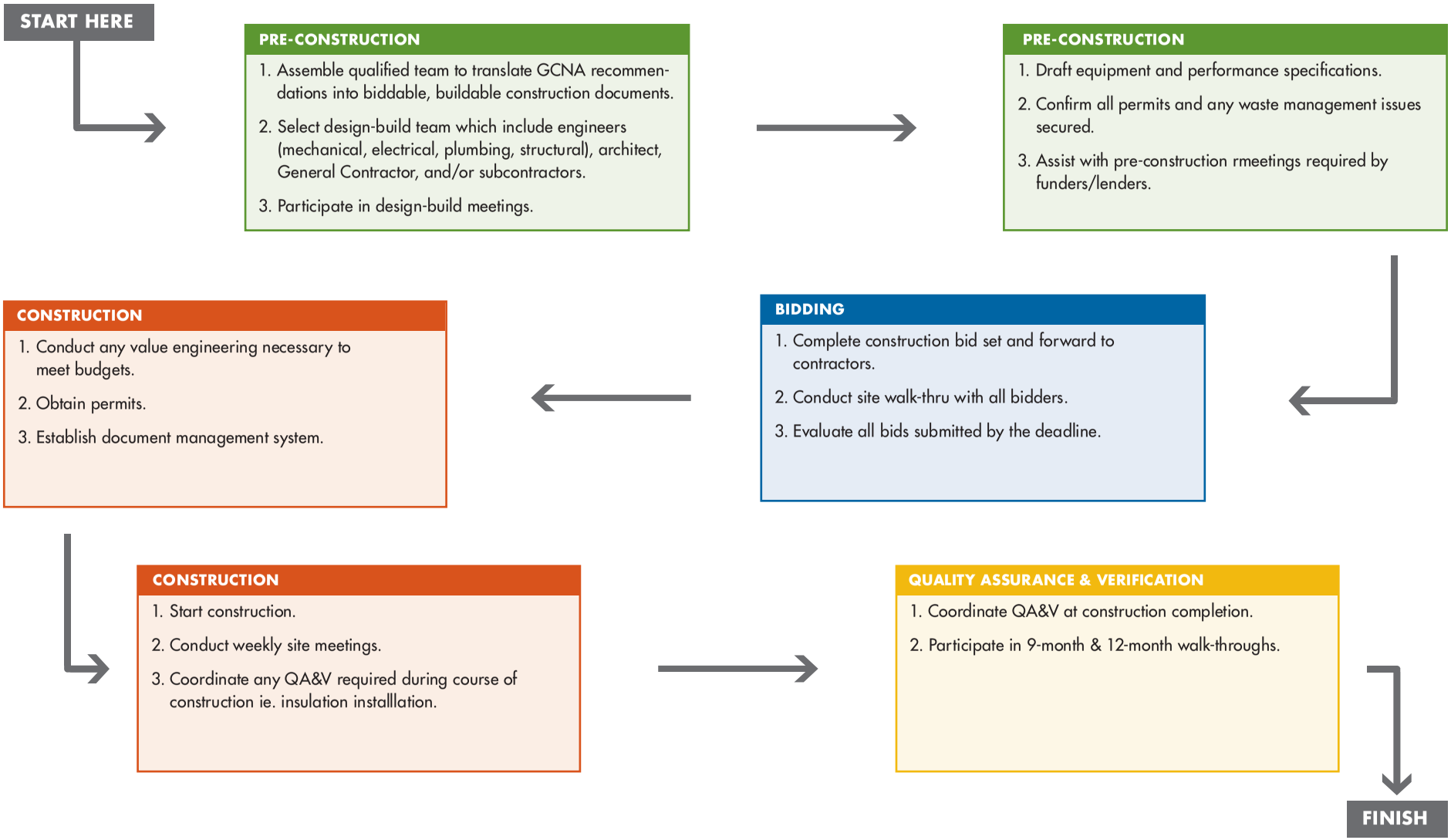
Master-Metered
- Rent increase/green marketing

Portfolio-Wide Approach

AFFORDABLE

- Carbon Market
  - Renewable Energy Certificate (RECs)
  - Voluntary Emissions Reductions (VERs)
- Portfolio-wide Loan – Line of Credit
- Bulk Purchasing
  Power Purchase Agreement – Portfolio-wide

P GREEN RETROFIT CONSTRUCTION FLOW CHART



CONSTRUCTION MANAGEMENT CHECKLIST

PRE-CONSTRUCTION SERVICES

- ○ 1 Help identify the experts needed to translate GCNA & Energy Audit recommendations into construction documents ie design-build General Contractor and/or mechanical, electrical, plumbing, structural engineers
- ○ 2 Help prepare for and participate in design-build meetings
- ○ 3 Review plans and specifications
- ○ 4 Assist owner in negotiations with General Contractor (GC) and with contract preparations
- ○ 5 Prep meetings Owner, Consultants and General Contractor (GC)
- ○ 6 Analyze development schedule
- ○ 7 Review all Contract Documents for consistency and accuracy
- ○ 8 Coordinate and confirm that all necessary Permits are secured in a timely manner
- ○ 9 Identify any special waste management issues and ensure that GC and subs are in compliance
- ○ 10 Assist Owner coordination with pre-construction meetings as required by all funders/lenders

CONSTRUCTION SERVICES

- ○ 1 Establish document management system
- ○ 2 Evaluate proposed revision/upgrades
- ○ 3 Coordinate work of other consultants ie structural engineer
- ○ 4 Monitor testing and inspection
- ○ 5 Review schedule and monitor progress
- ○ 6 Attend job meetings and facilitate resolution of issues
- ○ 7 Maintain records and Files
- ○ 8 Draft regular progress reports and meeting minutes
- ○ 9 Review and revise as necessary Payment Applications
- ○ 10 Review and negotiate Change Order Requests
- ○ 11 Participate in and/or coordinate punchlist walk

CONSTRUCTION CLOSE-OUT SERVICES

- ○ 1 Generate punchlist and make sure items are addressed
- ○ 2 Assist Operations & Maintenance, Warranty manuals and Project Manager O&M training
- ○ 3 Assist QA&V, systems testing
- ○ 4 Prepare written summary reports
- ○ 5 Participate in 9-month and 12-month walk-throughs