Enterprise green communities®

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

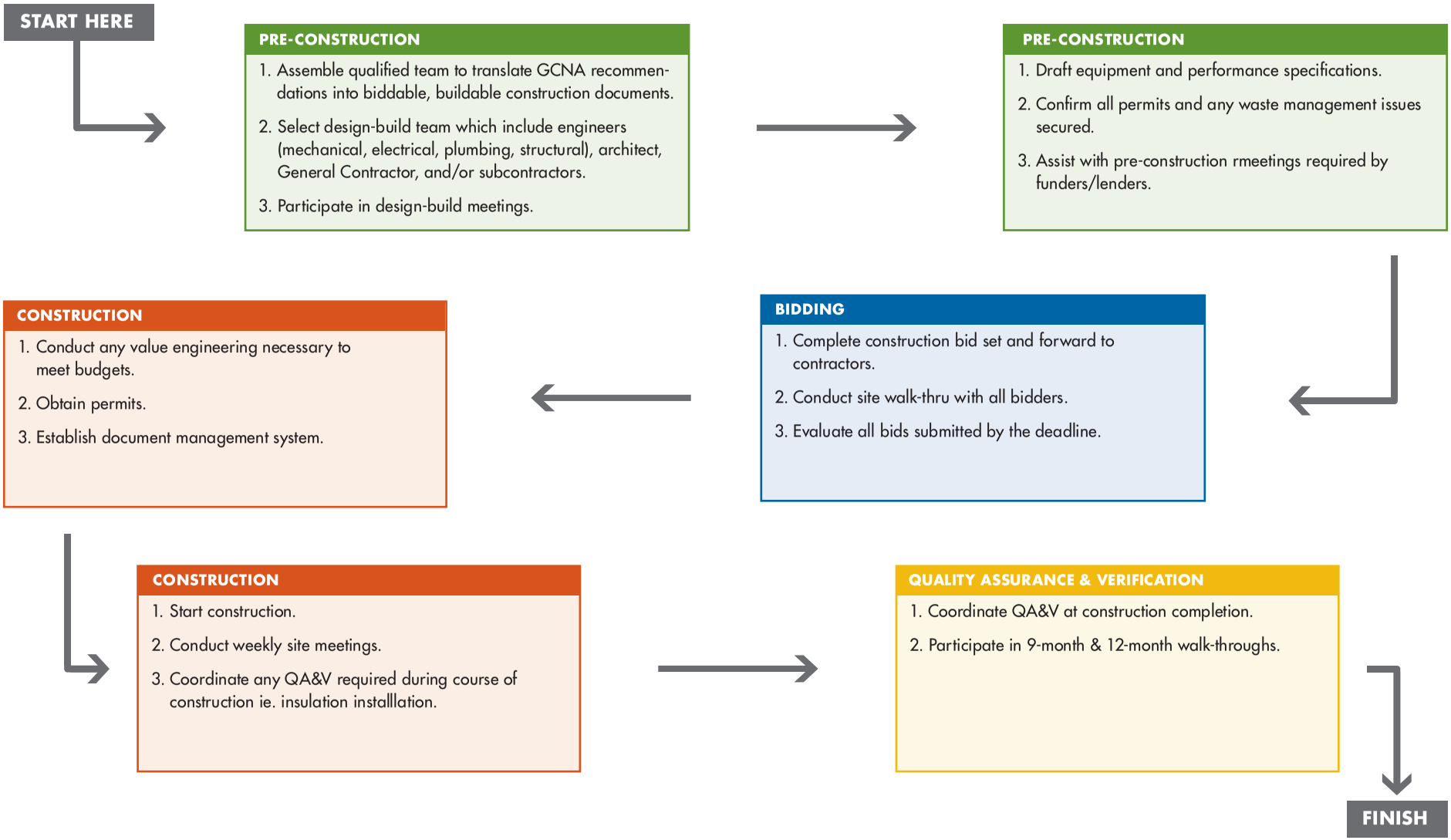
Master-Metered
- Rent increase/green marketing

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