OREGON HOUSING & COMMUNITY SERVICES Multifamily Energy Program

Energy Auditing 101

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AGENDA

- Purpose of energy audits
- Types of audits
- Preparation
- Audit practices & system types





WHAT IS AN ENERGY AUDIT?

- Survey of existing building conditions as they relate to energy use
- Goals:
 - Determine current energy uses
 - Determine energy saving opportunities
 - Identify and improve safety and comfort for residents
- Whole building audit or system-specific





ENERGY AUDITS: MULTIFAMILY ENERGY PROGRAM

	Path 1	Path 2	Path 3
	Menu	Bundle	Whole Building
Project Need	Projects only interested in limited measure upgrades	Projects interested in multiple upgrades	Buildings in need of audit to identify comprehensive upgrades
Measures	Choose <u>two</u> measures in	Bundled packages to suit	Whole building
	two different measure	varying scopes of work	improvements targeting
	categories	and needs	deep energy savings





TYPES OF AUDITS: ASHRAE 1/2/3

- Level 1:
 - No-cost/low-cost savings opportunities identified
- Level 2:
 - More intensive recommendations
 - Building energy use analysis
- Level 3:
 - Comprehensive recommendations
 - Financial analysis of major capital investment projects
 - May include monitoring, data collection, engineering analysis





TYPES OF AUDITS

Low Cost / **No Cost Options**

Depth of Audit

Major Capital Investments

One System

Breadth of Audit

Simple analysis of one system and a narrow list of measures

> Facility-wide analysis with rigorous quantification of project costs and savings; equipment specifications ready for bid documents

Source: https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20956.pdf





All Systems & System Interactions

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PRE-INSPECTION PREPARATION

Collect property details

- Location
- Size
- # of buildings
- # of units
- Age
- Discuss site with owner
 - Failing systems
 - Planned updates
 - Recent work completed



Make site visit plan, coordinate with owner/manager

- # of units to be entered, timing
- Equipment needed
 - CAS?
 - Ladder for attic access?
 - Non-standard testing? Duct blaster, blower door, thermal imaging, etc.





ENERGY AUDITS: WHAT TO EXPECT

Discuss site-specific conditions

- With manager, maintenance staff, and tenants as needed
- Inspect
 - Community spaces, exterior lighting, mechanical systems/rooms, and accessible attics/crawlspaces

Take photos for post-inspection report

• all existing conditions

Conduct in-unit surveys

- Appliances, in-unit lighting, water fixtures, and DHW & HVAC systems
- Combustion safety testing can be completed when applicable





AUDIT PROTOCOLS: RESNET

Sampling protocols

- Sample at least one of each unit type
- Units will be separated into groups ≤7 of the same type, and one of each group inspected

Full guidelines available at:

www.resnet.us/professional/standards/Adopted_RESNET_Guidlines_for_Multifamily_Ratings_ 8-29-14.pdf







AUDIT PROTOCOLS: BUILDING PERFORMANCE INSTITUTE

BPI Standards

Written standards for most aspects of energy audits/inspection

Standards/certification information available at:

www.bpi.org/standards/current-standards

Combustion appliance safety (CAS) protocols

- Not required, but recommended
- <u>Very</u> high potential safety impacts
- CAS Testing identifies:
 - Gas leaks
 - High CO
 - Incomplete combustion
 - Improper venting







LIGHTING



Edison Base GU-24 base

2-Pin

Compact Fluorescent Lights (CFL)





Mercury Vapor

Metal Halide

High Intensity Discharge Lights (HID)

Sodium (HPS)



Linear Fluorescent Lights







General use incandescent

Incandescent Lights

Halogen Incandescent

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LIGHTING RECOMMENDATIONS

• LEDs, available as:



Hardwired Fixtures



Note: OR-MEP incentivizes LED fixtures, not bulb replacements





• Lighting controls:

- Motion-activated
- Photosensor
- Timeclock

Typical wattage required for an 800 lumen bulb		
Incandescent	60 Watts	
CFL	13 Watts	
LED	8 Watts	

DOMESTIC HOT WATER (DHW)

Central DHW

- Boiler vs. Tank-type
 - Recommendation: Condensing



Central boiler DHW before



Central boiler DHW after





DHW (CONTINUED)

In-unit DHW

- Natural gas: tank vs tankless
 - Recommendations: Energy Star, condensing tankless
- Electric: electric resistance, tankless, heat pump
 - Recommendations: Tankless or heat pump









Electric Resistance Tankless





ADDITIONAL HOT WATER SAVINGS

Low flow fixtures

- Showerheads
- Kitchen and bathroom faucets or aerators



Recirculation pump controls











ADDITIONAL HOT WATER SAVINGS







BUILDING ENVELOPE & INSULATION

Insulation types:

- Batt
- Loose fill
- Rigid

• Air leakage through insulation:



Note blackened fiberglass







BUILDING ENVELOPE & INSULATION: RETROFITS

- Insulation locations:
 - Attic/roof
 - Crawlspace
 - Walls (EIFS)
- Air Sealing
- Windows



Single Pane Metal Framed Windows



Dual Pane Windows





HVAC

Heating Only

	Electric Resistance	Hydronic	Steam	Furnace
Energy Source	Electric	Dependent on DHW/boiler	Gas	Gas
Systems	Fan wall heater Forced air unit Baseboard	Baseboard Radiator Ducted Forced Air Unit	Baseboard Radiator	Wall Furnace Forced Air Unit
Distribution types	Forced air ductless Forced air ducted Natural convection	Natural convection Forced air ducted	Natural convection	Natural convection Forced air ducted
Typical Efficiency	~98%	Dependent on DHW/Boiler	75-85% (standard) 95% (condensing)	WF: 60-70% FAU: 80% standard to 95% condensing

Cooling Only

	Packaged Terminal Air Conditioner (PTAC)	Split System Air Conditioner
Energy Source	Electric	Electric
Systems	Fan wall heater	Forced air unit, outdoor compressor
Distribution types	Forced air ductless	Forced air ducted
Typical Efficiency	9-13 EER	10-16 EER





HVAC (CONTINUED)



Electric Resistance Wall Heater



Hydronic Baseboard



A/C Compressor



Radiator



Furnace



PTAC





HVAC (CONTINUED)

Cooling and Heating

	Packaged Terminal Heat Pump (PTHP)	Split System Heat Pump	Mini Split Heat Pump
Energy Source	Electric	Electric	Electric
Systems	Fan wall heater	Forced air unit, outdoor compressor	Fan wall heaters (head units), outdoor compressor
Distribution types	Forced air ductless	Forced air ducted	Forced air ductless
Typical Efficiency	9-13 EER 8-12 HSPF	12-18 EER 8-11 HSPF	15-26 EER 10-13 HSPF



Mini Split Compressor and Head Unit





HVAC: VENTILATION

Ventilation fans

- Bathroom, kitchen
- Manual, sensor-based, continuous
- Balanced vs. exhaust only

Balancing act: Indoor air quality vs. energy efficiency

Energy recovery ventilation





APPLIANCES

- Refrigerators & Dishwashers → Energy Star
- Washing machines \rightarrow Energy Star or better
 - Front loading models = more efficient than top loading
- Stoves → Induction











ELECTRICAL SYSTEMS



Main circuit breaker



Circuit breaker panel, with model info & labels

Also take note of:

- Solar PV system: size, condition, inverters, etc.
- Electric meters
- Old wiring: knob & tube, outlets without ground





DOCUMENTATION

Photos:

- Cover photo for report, site conditions
- Mechanical systems, lighting, water fixtures, insulation
- Any nameplates seen
- Conditions of note (hazardous, inefficient, etc.)
- Timeclocks, electric meters, circuit breakers

Notes:

- Site conditions as seen and reported by residents/staff
- Lighting types and counts, water fixture flow rates
- Insulation levels
- System notes/schematic for complicated and unexpected systems





FOLLOW-UP

Reporting

 Provide report of findings & recommendations, discuss with owners

Hazard Mitigation

• Confirm with owners that any health-related hazards have been handled, including photo documentation

Follow-up site visits

• As necessary for further testing, confirmation of installation, etc.





REPORT

- Cover page
 - Include site photo, name/address, relevant parties
- Table of contents
- Summary of recommended measures
 - Include energy savings if applicable
- Program details
- Existing conditions,
 - Include photos of existing conditions
- Recommended measures
 - Provide detailed description of measures
 - Program-required fixes: *Either include as a separate section or strongly emphasize them here*
- Appendices
 - Include results of energy modeling, additional analyses, non-energy related measures, or lengthy lists of recommendations that don't fit in
 - report





REPORT SAMPLE

Energy Analysis, Suggested Scope of Work, and Modeling Calculations for the Proposed Improvements at:

Walnut Place





John Neal (510) 431-1794 Brian Finn (510) 270-4957 Ineal@aea.us.org



Existing Conditions:

Exterior site lighting consists of a mix of CFL and fluorescent lights, and metal halide flood lights. The leasing office has been recently renovated and is lit primarily by LED fixtures throughout the interior and exterior of the building.



CFL Wall Sconce

Recommended Improvement:

Upgrade all exterior and common area lights to LED. CFLs in enclosed fixtures can be replaced with LED equivalent screw-in bulbs rated for enclosed fixtures. Wattages of new fixtures shown below represent modeled wattages only. Actual fixture wattage required may be more or less than indicated, and must be determined by a qualified professional. Some of the recommended wattages below will result in moderate energy savings, but greatly improved light levels. Final light levels and wattages should be determined by a qualified lighting designer/contractor. Savings for this measure will be recalculated based on actual fixtures to be used:

Location	Existing Lighting	Qty	Recommended Replacement
Pool Light	250W Incandescent	2	70W LED pool light
Exterior Pole	13W CFL Pin	13	10W LED
Exterior Flood	150W Metal Halide	16	30W LED Fixture
Wall Sconce Outsite units	13W CFL Pin	150	10W LED
Sign Light (1 on each building)	60W Incandescent	18	10W LED
Pagoda Site lighting	13W CFL Pin	16	10W LED
Maintenance Building Exterior	13W CFL Wall Sconce	2	10W LED
Carport	4' T5 Fluorescent Tube	71	18W LED Tube
Pool Pump Room	2 x 4' T12 Fluorescent Tube	1	2 x 18W LED Tube

For exterior fixtures and lamps, 4100K-5000K is the recommended color temperature.

LED fixtures also allow for an efficient distribution of light, which improves site safety while reducing the necessary amount of fixture lumens. When possible, it is recommended that lamps and fixtures be either Energy Star or Design Lights Consortium (DLC) approved.





KEY TAKEAWAYS



Energy audits begin with owner/manager meeting

On-site audits review and document all systems, site conditions, and a selection of units



Auditor must be familiar with common system types



Auditor will follow up with report and discussion of recommended measures





QUESTION BREAK

THANK YOU FOR ATTENDING

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