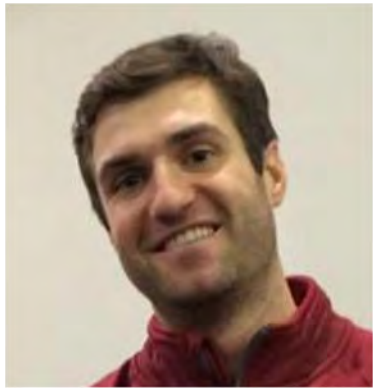
Tackle Energy Efficiency and Indoor Air Quality Together: Best Practices in Multifamily Housing Upgrades

Provided by the U.S. EPA in collaboration with U.S. HUD

October 2017

PRESENTERS



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U.S. HUD

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AGENDA

- Introduction (EPA/HUD)
- Why integrate indoor environmental quality measures into ongoing property management, preventative maintenance, building upgrades, and new construction?
- How to use the EPA's Energy Savings Plus Health Guide for Multifamily Building Upgrades
- Benefits of holistic approach to energy efficiency and indoor air quality
- Mankato and Hempstead case studies
- Q&A Session

LEARNING OBJECTIVES

Webinar Participants will learn how to:

- Get started implementing guidance from Energy Savings Plus Health: Multifamily Building Upgrades to integrate IAQ protections into multifamily energy efficiency retrofits and other building upgrade projects
- Create a custom verification checklist using the Multifamily Checklist Generator
- Apply best practices modeled by case studies from the Mankato Housing Authority and the Hempstead Housing Authority Pilot studies.

Better Buildings® CHALLENGE

U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF HOUSING & URBAN DEVELOPMENT

Multifamily Buildings Sector

115

Multifamily Sector Partners

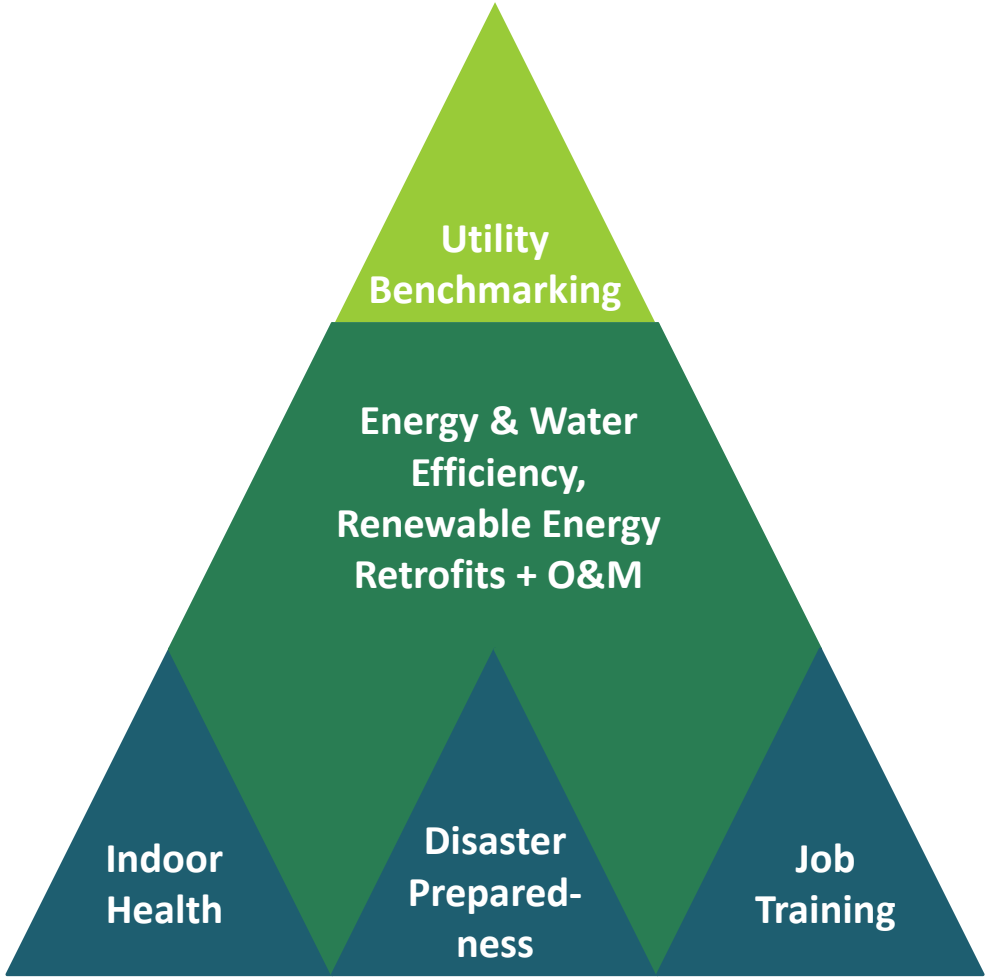
750,000

Housing Units

600 Million

Square Feet

How to get to a 20% consumption reduction?



What not to overlook along the way?

hudexchange.info/programs/better-buildings-challenge

- News & Announcements
- Events & Training
- Energy & Water Efficiency, Renewable Energy Case Studies
- Utility Benchmarking Toolkit & Tools
- Renewable Energy Toolkits & Tools
- BBC Financing Navigator
- ENERGY STAR Portfolio Manager Water Performance Score for Multifamily Buildings
- and more!

Indoor Air Quality for Multifamily Buildings

PRESENTATION BY THOMAS BOWLES, U.S. EPA

EPA Indoor Air Quality Programs Promoting Healthy Homes IAQ in Context at EPA

IAQ Protocols for Existing Building Upgrades

Labeling for New Homes

IAQ Protocols for Existing Buildings

Indoor airPLUS qualification is not available for existing homes (except in the case of gut rehabs).

For renovations in multifamily buildings, see EPA's Energy Savings Plus Health: Multifamily Building Upgrades (https://www.epa.gov/indoor-air-quality-iaq/energy-savings-plus-health-indoor-air-quality-guidelines-multifamily-building)

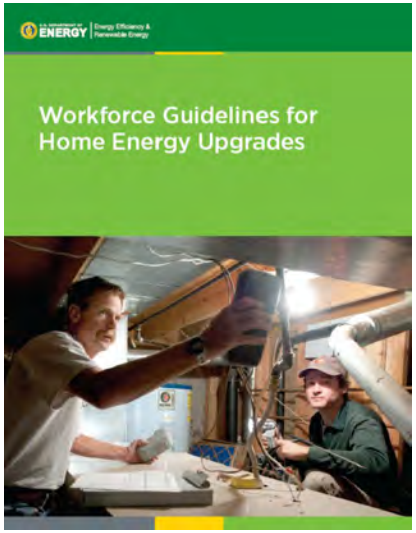
Renovating your home? EPA's Healthy Indoor Environment Protocols for Home Energy Upgrades (https://www.epa.gov/indoor-air-quality-iaq/protocols-home-energy-upgrades)

See Renovating a school building? See Energy Savings Plus Health: IAQ Guidelines for School Building Upgrades (https://www.epa.gov/iaq-schools/printable-version-energy-savings-plus-health-indoor-air-quality-guidelines-school)

More info at:
http://www2.epa.gov/indoor-air-quality-iaq/protect-indoor-air-quality-your-home

DOE Guidelines

US DOE Guidelines for Home Energy Professionals



Contains:

- Standard Work Specifications
- Referenced Technical Standards
- Define minimum requirements
- Define Proper Conditions
- Complementary and mutually supportive of EPA protocols

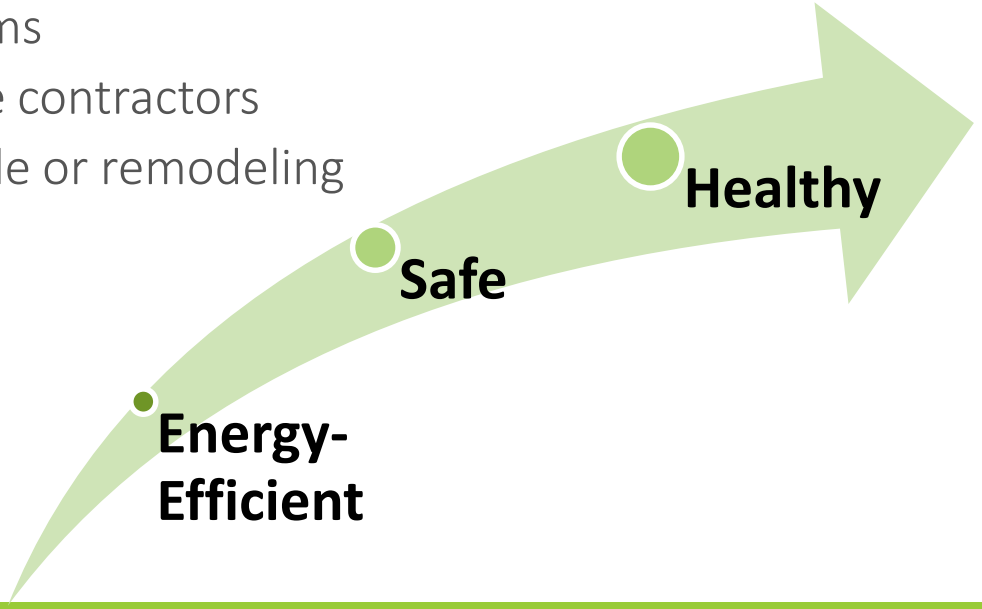
See the National Renewable Energy Lab's (NREL) "Standard Work Specifications" online tool: https://sws.nrel.gov/

Purpose of the Protocols

Practical, voluntary guidance for energy upgrades, retrofits, remodeling.

Intended for:

- Weatherization assistance programs
- Federally funded housing programs
- Private sector home performance contractors
- Others working on energy upgrade or remodeling



What is “Multifamily?”

These structures are often referred to as "multi-unit housing" or "multi-housing" and include:

- Attached townhouses
- Low-rise apartments and condos
- Mid-rise apartments and condos
- High-rise apartments and condos

Why Guidelines for Multifamily Building Upgrades?

- 80 million people live in multifamily dwellings
  - Many need retrofitting
- Upgrade activities potentially negatively affect IAQ
  - Asbestos, mold, lead containing materials may be disturbed during the upgrade process
- Need for guidance to ensure healthy indoor environments during upgrades
- Guidelines will help anyone involved in renovation/remodeling efforts integrate health protections into their projects.

Saves $$$

Proactive IAQ Management =

- ↑ Health
- ↑ Performance
- ↑ Cognitive Function
- ↑ Environment

Health Benefits

- Reduce Indoor Air Contaminants Linked to Chronic Illnesses
- Controlling Contaminants that Trigger Respiratory Symptoms
- (Asthma)
- Reductions in Healthcare Utilization
- Improved Occupant Health

Energy Savings Plus Health: IAQ Guidelines for Multifamily Building Upgrades

- Released January 2016
- Repair/Renovation Work
- Protecting IAQ during & after modifications
- Helpful to Industry
- Easy to use Checklist Generator Tool

Energy Savings Plus Health: Multifamily Building Upgrades
https://www.epa.gov/indoor-air-quality-iaq/energy-savings-plus-health-indoor-air-quality-guidelines-multifamily-building

Goal

Provide healthy and safe environments for our multifamily occupants and staff while saving energy and money.

The Energy Savings Plus Health Guide complements any IAQ, energy and sustainability plans already in place.

Multifamily vs Single-Family

Issues Unique to Multifamily

- Hazardous Materials (asbestos, lead, PCBs)
- Environmental tobacco smoke
- Air Pollutants
- Pests
- Radon
- Heating, ventilation and air conditioning equipment
- Compartmentalization to prevent odor or unwanted air transfer
- Local exhaust
- Multifamily building safety and O&M procedures/training for staff and occupants
- Protecting IAQ during construction

How do the Guidelines work?

Assessment Protocols

Measures to identify and evaluate potential IAQ and safety concerns in multifamily residential buildings undergoing upgrade activities. The assessments should be performed in all common areas of the building and in as many dwelling units as possible.

Minimum Actions

Critical actions intended to correct deficiencies identified during the assessments, incorporate minimum IAQ protections, and ensure that work does not cause or worsen IAQ or safety problems for occupants or workers (i.e., “Do No Harm”). EPA recommends these protections for all building upgrade projects.

Expanded Actions

Additional actions to promote healthy indoor environments that can be taken during many building upgrade projects. EPA recommends considering these improvements when feasible and sufficient resources exist.

Energy Savings Plus Health: Multifamily

Compartmentalization

PRIORITY ISSUE 16.0 COMPARTMENTALIZATION TO PREVENT ODOR OR UNWANTED AIR TRANSFER		
ASSESSMENT PROTOCOLS (AP)	**MINIMUM ACTIONS (MA)**	**EXPANDED ACTIONS (EA)**
AP 16.1 Determine Building Locations with Strong Pollutant Sources Determine which areas or dwelling units in the building are likely to be sources of irritating pollutants or noxious odors or where unwanted air transfer occurs. Refer to complaint logs and building owner/property manager reports, and perform an IAQ walkthrough inspection. Include common areas and nonresidential spaces in the building (e.g., retail spaces, fitness facilities, beauty and nail salons). To the extent possible, work with the building owner, property manager and other occupants to identify IAQ concerns that arise from pollutant migration among dwelling units, common areas and commercial spaces. Refer to EPA's Building Air Quality Action Plan for more information on IAQ walkthrough inspections. **AP 16.2 Assess Spaces for Compartmentalization** Identify spaces in the building with strong pollutant sources that could be isolated using compartmentalization techniques, including dwelling units, common areas, nonresidential spaces (e.g., conference/meeting rooms,	**MA 16.1 Minimize Pollutant Transfer Between Spaces** Follow the guidance in the order listed below for the most effective strategy: (1) Source Control, (2) Ventilation and Air Pressure Control, and (3) Air Sealing. *1. Source Control* If pollutant sources and odors were identified and can be readily addressed see the relevant priority issues in this Guide. For example – • For sewer gases or other pollutants, see Priority Issue 6.0 Belowground Contaminants. • For suspected VOCs, see Priority Issue 10.0 Building Products/ Materials Emissions. • For tobacco smoke transfer control, see Priority Issue 14.0 Environmental Tobacco Smoke (ETS). • For contaminants from attached garages, see Priority Issue 7.0 Garage Air Pollutants. • For wood smoke, see Priority Issue 15.0 Wood Smoke and Other Solid Fuel Emissions.	**EA 16.1 Expanded Ventilation and Air Pressure Control** Follow the Expanded Actions guidance in Priority Issues 18.0 through 21.0, as applicable to the type of ventilation system. Reduce excess negative pressures inside the dwelling units resulting from unbalanced exhaust systems. If the existing ventilation exhaust system relies on a central exhaust, specify and install a new balancing device at each exhaust point with a minimum operating pressure to help ensure that required airflow and system performance are not significantly affected by stack effect. **EA 16.2 Expanded Air Sealing for Dwelling Units** If the building is undergoing extensive rehabilitation, extend compartmentalization efforts to all dwelling units. Provide air sealing in all separating walls, floors and ceilings to achieve compartmentalization within each dwelling unit, with an airtightness of 0.3 cfm per square foot of enclosure area (i.e., sum of all wall, ceiling and floor areas) at 50 Pascals

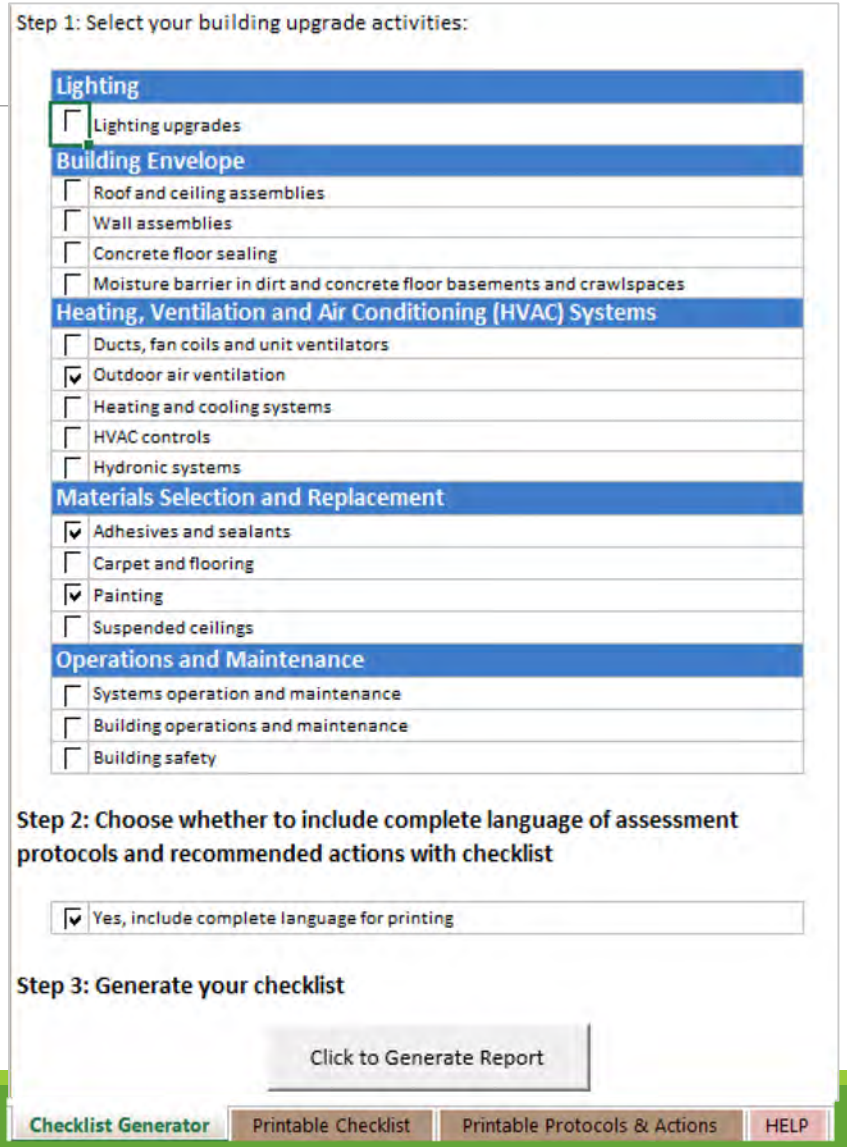
You have too much to deal with! How do you organize?

Checklist Generator Tool

Excel Checklist Generator

- Create customized checklists for each project.
- Select types of building upgrade activities
- Choose to include complete language of protocols
- Generate Report

Download the Multifamily Checklist Generator Tool (XLSM)



Customized Checklist

United States Environmental Protection Agency

Color Code: Assessment Protocol (AP) | Minimum Action (MA) | Expanded Action (EA)

Energy Savings Plus Health: Indoor Air Quality Guidelines for Multifamily Building Upgrades

Verification Checklist

Building:

City/State/Zip: Date:

Building Upgrade Activities Selected					
X	Lighting upgrades		Ducts, fan coils and unit ventilators		Carpet and flooring
	Roof and ceiling assemblies		Outdoor air ventilation		Painting
	Wall assemblies		Heating and cooling systems		Suspended ceilings
	Concrete floor sealing		HVAC controls	X	Systems operation and maintenance
	Moisture barrier (basement and crawlspace flo		Hydronic systems		Building operations and maintenance
			Adhesives and sealants		Building safety

		Assessment Protocol and Action Verification	Complete	N/A	Notes
		1.0 Moisture Control and Mold			
AP	1.1	Inspected the interior and exterior of the building and the building's mechanical systems for evidence of moisture problems, and documented the results.	☐	☐	
MA	1.1	Repaired moisture problems identified during the assessment including plumbing leaks, rain leaks, and foundation leaks.	☐	☐	
MA	1.2	Conducted mold remediation following professional guidance, such as EPA's Mold Remediation In Schools and Commercial Buildings and IICRC Mold Remediation Standard S520.	☐	☐	
MA	1.8	Used nonporous construction materials in moisture-prone areas.	☐	☐	
EA	1.2	Followed EPA or other professional guidance to perform additional activities to remediate mold growth.	☐	☐	
		2.0 Asbestos			
AP	2.1	Determined potential asbestos hazards in the building and identified asbestos-containing materials (ACM). Completed assessments for ACM prior to initiating building upgrade tasks that have the potential to disturb ACM.	☐	☐	
AP	2.2	If unsure whether material contains asbestos, contacted a trained and accredited asbestos professional to assess, sample, and test the material, as needed. Notified the building owner and/or property manager of any ACM identified during the assessments.	☐	☐	
MA	2.1	Addressed ACM during building upgrades and used accredited personnel for abatement or repair. Immediately isolated the area if suspected ACM was found to be damaged (e.g., unraveling, frayed, breaking apart). For suspected ACM that must be disturbed as part of the project, contacted an accredited and properly trained	☐	☐	

Examples of Multifamily Residential Building Upgrade Projects

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
LIGHTING		
Lighting Upgrades • De-lamping: Removing unnecessary light bulbs/ fixtures to save energy • Re-lamping: Replacing lighting components and fixtures • Upgrading ballasts • Other modifications or upgrades (e.g., occupancy sensors)	**IAQ/Health Risks:** • Asbestos-containing material, lead paint or polychlorinated biphenyls (PCBs) may be disturbed during lighting replacement. PCBs may be present in older fluorescent light ballasts that are not labeled "No PCBs" or "electronic." • Mercury vapor or mercury-containing powder from broken fluorescent bulbs or improper use of drum-top crushers may be present. • Lighting upgrades likely will reduce sensible heat loads, which may affect moisture removal performance of HVAC systems. **Opportunities:** • Remove and replace old fixtures containing hazardous materials with those that contain less hazardous materials. • Properly dispose of lamps containing mercury and fixtures containing PCBs.	2.0 Asbestos 3.0 Lead 4.0 PCBs 10.0 Building Products/Materials Emissions 17.0 HVAC Equipment 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
BUILDING ENVELOPE		
Roof and Ceiling Assemblies • Repairing or replacing the roof • Upgrading roof and ceiling insulation • Upgrading moisture protection • Upgrading air sealing	**IAQ/Health Risks:** • Asbestos-containing material, lead paint, PCBs or mold may be disturbed. • Installing spray polyurethane foam (SPF) may generate indoor contaminants. • Moisture may be trapped behind spray foam insulation when installed under a low pitch wooden roof deck, creating the potential for hidden, structural roof damage and mold. • Moisture may be trapped in insulation installed adjacent to drainage planes, vapor barriers or roof membranes. • Sealing the building envelope may increase levels of indoor contaminants, including radon, combustion by-products, moisture and mold, and volatile organic compounds (VOCs). Adequate ventilation must be provided to dilute and remove indoor pollutants. Radon mitigation systems may become necessary. **Opportunities:** • Control for moisture by selecting moisture-resistant insulation, properly installing insulation materials, and ensuring surfaces and assemblies with condensation potential are properly sealed and insulated to avoid dew-point conditions. • Seal unwanted openings and leaks in the building envelope to reduce air infiltration and conditions conducive to pest entry.	1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
Concrete Floor Sealing • Repairing and sealing floor penetrations • Sealing cracks and joints in floors • Applying floor sealer/ paint	**IAQ/Health Risks:** • Asbestos-containing material, lead paint, PCBs or mold may be disturbed. • Sealing the building envelope may increase levels of indoor contaminants, including radon, combustion by-products, moisture and mold, and VOCs. Adequate ventilation must be provided to dilute and remove indoor pollutants. **Opportunities:** • Understand and appropriately manage moisture emission rates and select sealants/adhesives with low-VOC or no-VOC content/emissions. • Reduce infiltration and conditions conducive to pest entry. • Seal cracks and joints in floors, which may be an integral part of a radon mitigation system.	1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
Outdoor Air Ventilation (upgrades or modifications) • Outdoor air intakes and controls • Filtration of outdoor ventilation air and make-up air • Local exhaust for indoor areas with strong sources of pollutants • Additional dehumidification, as needed for humid climates	**IAQ/Health Risks:** • Asbestos-containing material, lead paint or PCBs may be disturbed during wall, roof or ceiling penetrations. • Some locations may have strong outdoor pollutant sources in the proximity of outdoor air intakes. • Smoking near outdoor air ventilation intakes can increase indoor exposure to environmental tobacco smoke. • Humid climates may require additional dehumidification when the outdoor air supply is increased. • Excessive moisture promotes pest infestation. • Noisy ventilation systems may be turned off by occupants, which will negatively affect ventilation. **Opportunities:** • Ensure that outdoor air controls are working properly, while controlling for moisture. • Ensure the proper location of outdoor air intakes. • Ensure that all occupied spaces are provided with adequate outdoor air ventilation. • Ensure any filter status pressure sensors and switches are calibrated regularly.	1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 14.0 Environmental Tobacco Smoke 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects

Examples of Multifamily Residential Building Upgrade Projects	Examples of IAQ/Health Risks and Opportunities	Potentially Applicable Priority Issues
MATERIALS SELECTION AND REPLACEMENT		
Adhesives and Sealants • Application of materials used during energy upgrades for air sealing • Application of materials used for adhering and fastening components	**IAQ/Health Risks:** • Asbestos-containing material, lead paint or PCBs may be disturbed when removing previously installed adhesives or sealants. • Weatherization and air sealing can reduce air exchange rates and result in elevated levels of contaminants indoors if there is inadequate ventilation. **Opportunities:** • Always select sealants and adhesives for indoor use with low-VOC or no-VOC content/emissions. • Select outdoor sealants for long life to keep out water and, when possible, with low-VOC or no-VOC content/emissions. • Ensure adequate outdoor air ventilation after weatherization and air sealing.	2.0 Asbestos 3.0 Lead 4.0 PCBs 10.0 Building Products/Materials Emissions 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety
Carpet and Flooring • Replacing existing carpet • Installing new carpet over uncarpeted areas • Replacing or repairing existing floor tiles • Installing new flooring over existing floor surfaces	**IAQ/Health Risks:** • Asbestos-containing material (many floor tiles in older buildings were made of asbestos), lead paint, mold or large quantities of dust may be disturbed. • Carpet and flooring may be contaminated with PCBs if PCBs have migrated via indoor air from caulk and/or lighting ballasts that contain PCBs. **Opportunities:** • Isolate the work area to reduce dust migration caused by carpet and flooring removal. • Select low-VOC materials, including carpets, resilient flooring, adhesives and sealants.	1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 4.0 PCBs 9.0 Tracked-In Pollutants 10.0 Building Products/Materials Emissions 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

Examples of Multifamily Residential Building Upgrade Projects

OPERATION AND MAINTENANCE		
Systems Operation and Maintenance • Check control systems and devices for evidence of improper operation on a regular schedule (e.g., semiannually) and take corrective actions • Calibrate and periodically recalibrate sensors (e.g., temperature, humidity) • Perform cooling unit drain pan maintenance • Replace filters • Clean supply diffusers, return registers and outside air intakes • Keep unit ventilators and other duct openings clear of obstructions • Perform regular system operational checks • Check occupancy sensors	**IAQ/Health Risks:** • Asbestos-containing material, lead paint, PCBs or mold may be disturbed. • Deferred maintenance can lead to system degradation and IAQ problems. • Improperly maintained and uncalibrated sensors can lead to poor system performance and IAQ problems. • Poor air filtration and maintenance can lead to clogged coils and a need for expensive cleaning that can be avoided with proper maintenance. • Inadequate drain pan design or maintenance can lead to microbial contamination. • Inadequately maintained combustion equipment can result in improperly vented combustion gases and occupant exposure to carbon monoxide. **Opportunities:** • Ensure the proper operation and venting of combustion appliances. • Install and maintain carbon monoxide detection and warning equipment. • Control for moisture by maintaining humidity levels. • Ensure that particle removal filtration systems are operating properly. • Repair or adjust drain pans to drain completely. • Ensure that occupancy sensors are operating properly. • Implement a scheduled inspection and calibration/recalibration program (e.g., semiannually) for measurement sensors, paying special attention to the systems that are intended to supply outdoor air ventilation.	1.0 Moisture Control and Mold 2.0 Asbestos 3.0 Lead 5.0 Radon 6.0 Belowground Contaminants 7.0 Garage Air Pollutants 8.0 Pests 10.0 Building Products/Materials Emissions 11.0 Vented Combustion Appliances 12.0 Unvented Combustion Appliances 13.0 Ozone From Indoor Sources 17.0 HVAC Equipment 18.0 Mechanical Ventilation for Individual Dwelling Units 19.0 Mechanical Ventilation for Multiple Dwelling Units Using Central Exhaust 20.0 Natural (Not Fan-Powered) Ventilation 21.0 Local Exhaust Ventilation 22.0 Building Safety for Occupants 23.0 Protecting IAQ During Construction 24.0 Jobsite Safety

The Energy Savings Plus Health Guide Can Help You!

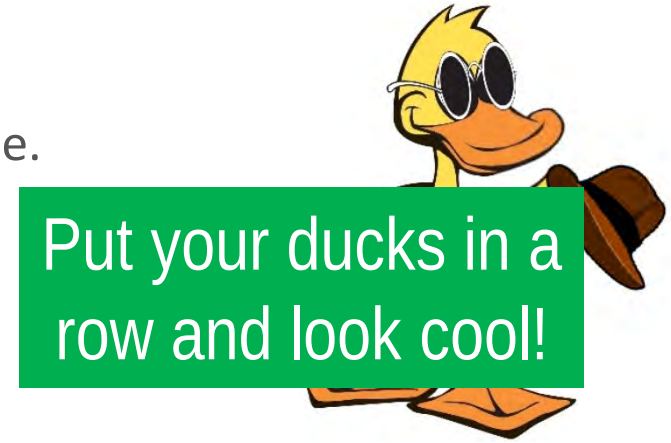
Keep your staff and contractors organized.

Keep occupants and workers safe and healthy.

Avoid IAQ risks due to upgrades and operations and maintenance activities.

Use for daily operations and maintenance.

Use for preventative or deferred maintenance.



https://www.epa.gov/indoor-air-quality-iaq/energy-savings-plus-health-indoor-air-quality-guidelines-multifamily-building

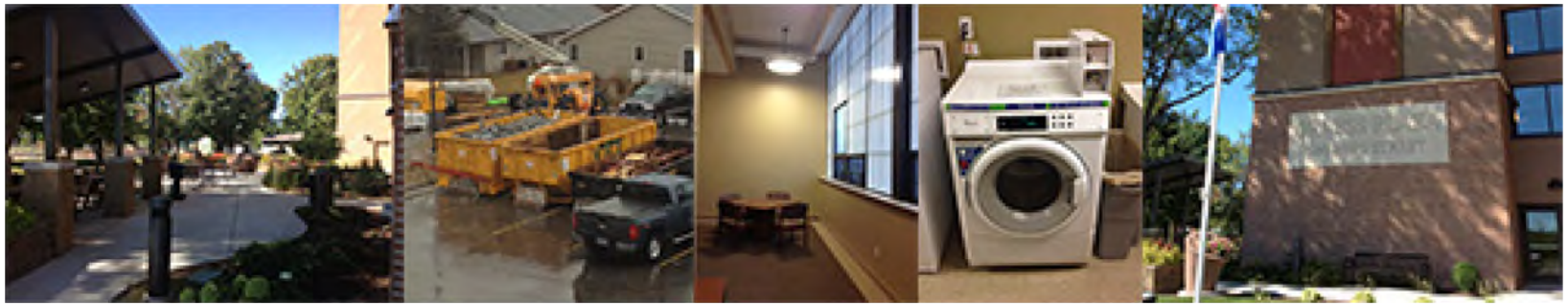
Need Help on the ES+H Guide?

Review the resources provided by EPA: https://www.epa.gov/indoor-air-quality-iaq/protect-indoor-air-quality-your-home

Contact us with questions or if you need help testing the ES+H Guide: bowles.thomas@epa.gov

City of Mankato Case Study

PRESENTATION BY WILLIAM WEBER



Tackle Energy Efficiency and Indoor Air Quality Together:
Best Practices in Multifamily Housing Upgrades

Orness Plaza

Integrated Design for Health,
and Environmental Improvement in Green Buildings

And, the Green Rehabilitation of Elder Apartment Treatments: The GREAT Study

William Weber
Center for Sustainable Building Research, UMN
wmweber@umn.edu

Center for Sustainable Building Research

THE PROJECT

ORNESS PLAZA, MANKATO, MINNESOTA

101 UNITS MIXED INCOME APARTMENTS

1 BUILDINGS/7 STORIES

CONSTRUCTED 1971

RENOVATED 2014

LEED ND SILVER (V3 2009)

GREEN COMMUNITIES CRITERIA W/MINNESOTA OVERLAY

BUDGET

$9,862,985.62 TDC

PRIMARY FUNDING

AMERICAN RECOVERY AND REINVESTMENT ACT THOUGH A HUD COMPETITIVE CAPITAL GRANT

MN DEPARTMENT OF EMPLOYMENT AND ECONOMIC DEVELOPMENT

MANKATO ECONOMIC DEVELOPMENT AUTHORITY

GREATER MINNESOTA HOUSING FUND

SOUTHWEST MINNESOTA HOUSING PARTNERSHIP

PROJECT TEAM

MANKATO EDA (OWNER - DEVELOPER)
SWMHP (DEVELOPMENT PARTNER)
BLUMENTALS ARCHITECTURE (ARCHITECT)
STEEN ENGINEERING (MECHANICAL)
ULTEIG (STRUCTURAL)
R.W. CARLSTROM, CO. (GENERAL CONTRACTOR)
QUESTIONS AND SOLUTIONS ENGINEERING (COMMISSIONING)
THE CENTER FOR ENERGY AND ENVIRONMENT (ENERGY AUDIT)

RESEARCH TEAM

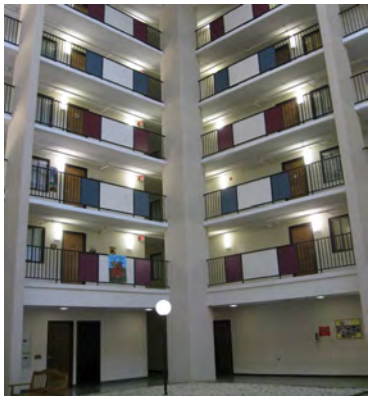
NATIONAL CENTER FOR HEALTHY HOUSING
SOUTHWEST MINNESOTA HOUSING PARTNERSHIP
CENTER FOR SUSTAINABLE BUILDING RESEARCH, UMN

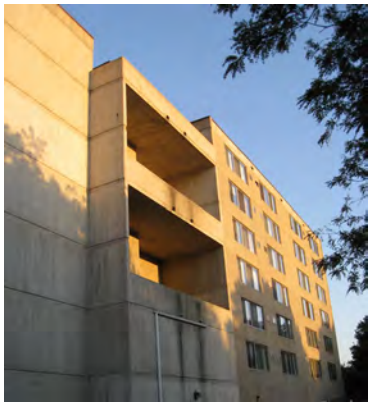
THE GREAT STUDY SPONSOR

HUD OFFICE OF LEAD HAZARD CONTROL AND HEALTHY HOMES

BLUE CROSS BLUE SHIELD FOUNDATION OF MINNESOTA (PLANNING CHARRETTE)

Process





Charrette/Kick-off
Clear Vision and Intention
Consensus on the intention and vision
Design for Health – IAQ and the Elderly
Identifying key issues envelope and mechanical systems
Working groups for key areas
Qualitative and quantitative factors in decision making

Design and Construction
Working groups for key areas
Qualitative and quantitative factors in decision making

- Cost, efficiency, life cycle, maintenance
- And…
- Impact on thermal comfort, moisture risk, durability,
- VOC content, and constructability.
- Impact on residents during construction

EPA's Energy Savings Plus Health: Indoor Air Quality Guidelines for Multifamily Building Upgrades

All 24 Action Areas Apply the key factors were the following:

Moisture Control and Mold
Asbestos and Lead
Pests
Building Products/Materials Emissions
Unvented Combustion Appliance
Environmental tobacco smoke
Compartmentalization to prevent odor or unwanted air transfer
HVAC Equipment and Mechanical ventilation Individual Dwelling Unit
Natural Ventilation
Local exhaust ventilation
Building safety for occupants
Protecting IAQ during construction
Jobsite Safety

Decision Making - Mechanical Matrix

Orness Plaza Mechanical System Options

System Type	System Description	Pros	Cons	Efficiency Htg/Clg	Maintenance / Life Expectancy (LE)	HVAC Cost/Unit **
4-Pipe Fan Coil	Requires both chiller and boiler plant. Existing Boiler plant can be used as is. Chillers are located on the roof or on grade. This system has a double loop, one carrying cold water and one carrying hot water. Hi-efficiency 90+% condensing boiler sized at 30% load could be added for shoulder seasons.	365 days of comfort with the best comfort control can be heating and cooling on the same day in different parts of the building. Very quiet. Existing fin-tube radiation can be re-used. Concealed horizontal or vertical stacking fan coils available. Most widely used system for high-rise condominiums or apartments	Space needed for central chiller, which may require additional structural support and vibration isolation. Separate metering is difficult and expensive if required.	85% htg / 14 EER clg	Fan coils are relatively low maintenance. Filters Clean Coils Chiller is relatively low maintenance LE chiller = 25 yr LE fan coil = 20	$6500
VRF DX Split-System with HW Baseboard	Console type indoor cooling fan coils with HW heat. Ductless Fan coils are hung on wall. Multiple indoor units are piped to single condensers (up to 10 or 12 to 1). The DX lines capable of 300 feet distance from fan coil. Heat pump heat good to about 30 degrees F. Requires supplemental heat (HW baseboard).	16 SEER Cooling, 4+ COP heating (above 30 F). No FC closet necessary. No through-wall louver. Significantly reduces number of outdoor condensers. Good individual comfort control. Existing fin-tube radiation can be re-used.	Console wall unit is not concealed. Larger outdoor condensers required. Estimated 8 required; 4 on roof and 4 on grade. Heating only functions above 25 Deg F. Overall equivalent efficiency is about 2.5 COP	80% and 2.5 COP 16 SEER	Verify refrigerant charge Indoor wall units are relatively low maintenance Filters Outdoor condensers require routine service and cleaning LE = 15-20 yr	$7000
Geothermal Hybrid Heat Pump System	Geothermal vertical heat exchanger well field augmented with High efficiency boiler plant and Cooling Tower. A compressor then either runs forwards or backwards depending on whether you need cold or hot air. Like the old freezer defrost button.	Very good control, can be heating and cooling on the same day in different parts of the building.	Requires more maintenance due to refrigeration in each heat pump. Heat pumps with compressors can be noise concerns. Heat pumps require more access and are slightly larger than fan coils thus requiring larger closets. Heat pump heat is forced air and delivered at a cooler temp (~85 deg)	80% and 4+ COP 18 SEER	Heat pumps: verify refrigerant charge, filters, require routine service Supplemental cooling tower requires routine service and chemical treatment LE geo field = 50 yr LE heat pumps = 15-20 yr	$9,000

* Central duct system for make-up air ventilation is recommended for any chosen system and are not included in unit prices.

** Cost estimates are approximate and do not include plumbing, common amenity space heating/cooling and assumes boiler and heating distribution piping may be reused.

COP (Coefficient of Performance) -

A ratio calculated by dividing the total heating capacity provided by the refrigeration system, including circulatory fan heat (BTU's per hour), by the total electric input (watts) X 3.412 (Btuh/watt). By definition the COP of electric heat is 1.0.

EER (Energy Efficiency Ratio) -

A ratio of cooling capacity in Btu's per hour (Btuh) divided by Power input (watts) at any given set of rating conditions, expressed in Btuh per watt.

SEER (Seasonal Energy Efficiency Ratio) -

The total cooling of an air conditioner or heat pump in Btu's during its normal annual usage period for cooling divided by the total electric energy input watt-hours during the same period. Takes into account cycling as well as the electricity used by the indoor blower motor, outdoor fan motor, and compressor. Used in systems producing up to 65,000 Btu's of cooling (1-5 tons).

Integrated Energy and IAQ– Solutions

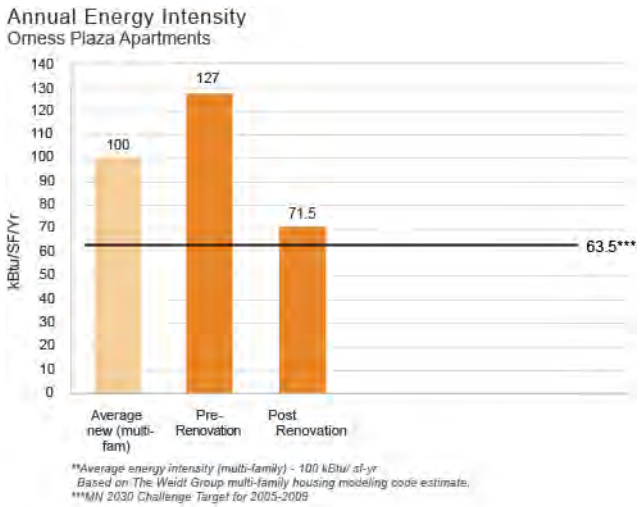
Comfort and Moisture
Envelope improvements, stabilizing the primary concrete structure; insulation, air sealing new cladding systems and windows

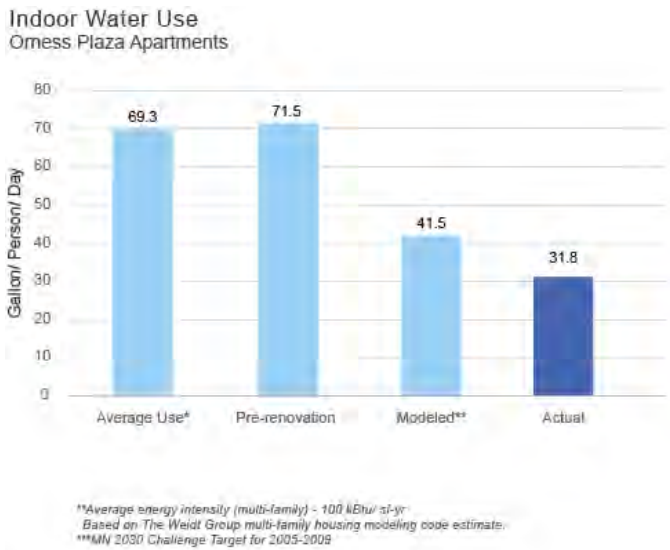
Central geothermal heat pump fed water loop for building and apartments heat and cooling

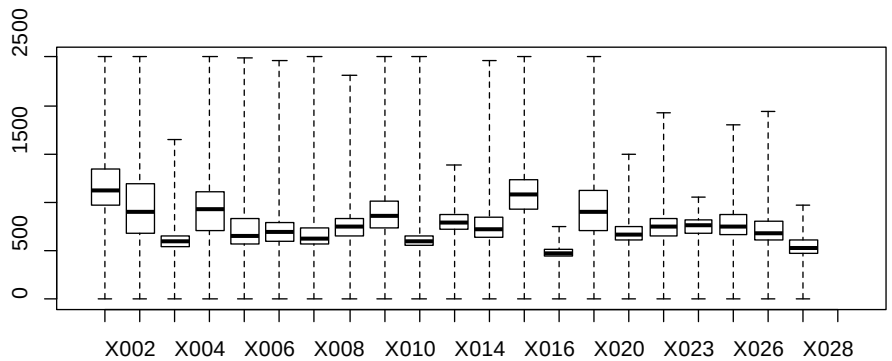
Air Quality
Ventilation via a Dedicated Outdoor Air System to each apartment, balanced with bathroom exhaust fans
Low/no VOC paints, sealants, and adhesives; green label carpet; moisture-resistant tub/shower enclosure materials;
no-smoking policy

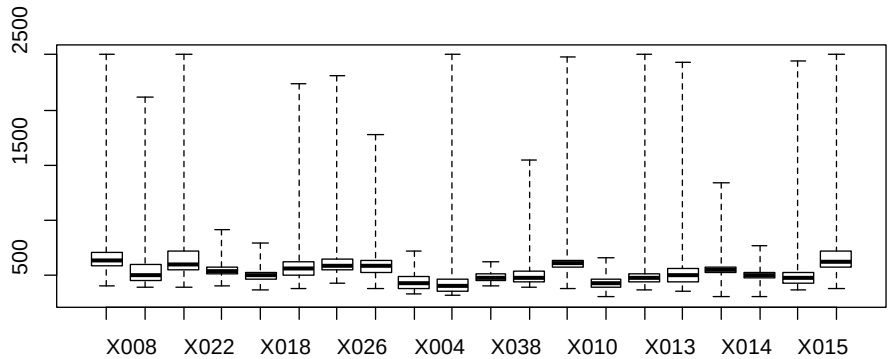
General
lead-safe work practices;
asbestos tile and mold abatement;
Protecting IAQ during construction

Building Outcomes – energy, water and IAQ









3 Month Comparison of combined unit pre (top) and post (bottom) construction CO_2 levels. The plot illustrates the minimum, first quartile, median, third quartile and maximum points for the given observations

The GREAT Study – Health Outcomes

Results: The all-ages study group's mental health improved significantly more than the comparison group's mental health on the basis of mean number of good mental health days in the past month (P = .026) and mean VR-12 mental component score (P = .023).

Sixteen percent fewer all-ages study group people versus 8% more comparison group people reported falls J Public Health Management Practice, 2015, 21(4), 355–367 (P = .055).

Significantly fewer people in the all-ages group reported smoke in their apartments because of tobacco products (20% vs 0%, P = .005), likely reflecting the new no-smoking policy.[1]

[1] Self-Reported Health Outcomes Associated With Green-Renovated Public Housing Among Primarily Elderly Residents Jill Breysse, MHS, CIH; Sherry L. Dixon, PhD; David E. Jacobs, PhD, CIH; Jorge Lopez, BS; William Weber, March Journal of Public Health Management and Practice. 21(4):355–367

E R

Thank you.

EPA

Hempstead Housing Authority Case Study

PRESENTATION BY ROSEMARY OLSEN

PUBLIC HOUSING HEALTHY HOMES PILOT

HEMPSTEAD HOUSING AUTHORITY NY085

SHOWCASE PROJECT

Gladys Gardens

by Rosemary Olsen

Gladys Gardens, Village of Hempstead, NY

Thirty (30) unit family townhouse development owned and operated by Hempstead Housing Authority

Built in 1972 – approximately 36,000 sq. ft. as public housing

Heated via a natural gas fired boiler with hot water baseboard heating – heating and leaking hot water system on its last legs.

Drafty windows, insufficient insulation, leaking roofs, failing leaders & gutters and incandescent lighting.

Hempstead Housing Authority (HHA) 2013

HHA was designated a “troubled” public housing authority.

HHA was in severe financial distress due to fraud and mismanagement.

Significant deferred maintenance problems. The Mayor’s office received many complaints about insufficient heat.

Gladys Gardens was in the worst condition. One of the tenants was complaining at public meetings about her home that “It stinks” due to moisture issues in the crawlspace below.

Solutions

Joined Better Buildings Multifamily Challenge and have been benchmarking with Wegowise.

Preconstruction testing (AP 2.2 *asbestos)* and (AP 3.1 *lead paint*) with no hazards found.

HUD Capital Fund Project (CFP) – replaced severely leaking hot water piping and installed pipe insulation in crawl space prior to retrofit project (AP 1.1 *moisture assessment*, MA 1.1 *moisture repair*). Cost = $106,788

Applied to Community Development Corporation of Long Island (CDCLI) for federal Weatherization Assistance Program.

Partnership for Healthy Homes Pilot

CDCLI was granted a health & housing funding from NeighorWorks America and Chase Foundation.

Federal Weatherization Assistance Program (WAP) and Low Income Home Energy Assistance Program (LIHEAP) funded the retrofit costs.

HUD Public Housing Capital Fund Program (CFP) funded the owner's contribution, boiler design, and training expenses.

Project Planning

CDCLI BPI Multifamily Building Analysts conducted an energy audit, health & safety assessment and resident survey. (AP 1.1 *moisture,* AP 11.1 *vented combustion appliances*, AP 16.1 *odor,* AP 17.1 *HVAC equipment*, AP 21.1 *exhaust ventilation*, AP 22.1 *safety hazards*)

CDCLI Residential Rehabilitation Analysts conducted additional health & safety inspection and resident survey in coordination with HHA inspectors. (AP 1.1 *moisture*, AP 8.1 & 8.2 *pests,* AP 22.1 *safety hazards*, AP 22.2 *smoke, co detectors*). Replaced non-functioning smoke and CO alarms (MA 22.2).

HHA hired Bright Power, an energy management firm to design, develop specifications for the new gas fired boiler and heating/DHW plant, and conduct post construction inspection of unit. (AP 17.2 *HVAC sizing*, MA 17.1 , MA 17.2,17.3, MA 17.4 *new HVAC installation)*

A scope of work was developed and CDCLI and put the projects out to bid.

Measures Installed

New condensing boilers, piping, boiler venting, and fiberglass pipe insulation. Cost: $173,400 (MA 17.2 - 17.4 *HVAC installation.* MA 1.6 *HVAC insulation,* MA 1.7 *HVAC sizing*)

Low-e argon filled thermal pane windows, with air sealing of frames. (MA 1.6 *air sealing)* Cost: $104,600 ($54,078 WAP funds, $50,522 owner CFP funds).

12” loose cellulose attic insulation with air sealing. (MA 1.6 *insulation*) Cost: $44,500.

Retrofit Project

Replacement of all lighting throughout with LED fixtures. (MA 4.1 *lighting replacement*) Cost: $31,900.

Bathroom fans for ASHRAE ventilation compliance (MA 21.1 *bathroom exhaust fans* (EA 21.2 *automatic timer*) Cost: $24,000

New roof with ridge venting, leaders and gutters. (MA 1.4 *manage rainwater, drainage away from building*) Cost: $80,000 (Chase Foundation)

Maintenance staff - BPI Multifamily Building Operator training (MA 17.5 *staff training on HVAC operation & maintenance*) (CFP funds and NYSERDA)

Indoor Air Quality with Health & Safety Improvements

1.0 – Moisture Control and Mold

- Replacement of leaking hot water pipes, roof, leaders & gutters, boiler & hot water system, windows.
- Air sealing, pipe insulation, attic insulation

2.0 – Asbestos: Testing

3.0 – Lead Paint: Testing

4.0 – PCBS: Lighting replacement with LEDs

8.0 – Pests: Inspection and mitigation

11.0 - Vented Combustion Appliances: safety inspection

17.0 – HVAC Equipment: testing, design & replacement, training

21.0 – Exhaust Ventilation: installed bath fans with automatic timer

22.0 – Building Safety for Occupants: Safety inspections and smoke/co detector replacement.

Energy Project Cost: $378,400

ANNUAL ENERGY USE (SOURCE EUI)

Baseline (2013): 100 kBtu/sf/yr

Actual (2016): 60 kBtu/sf/yr

Actual Energy Savings: 40%

ANNUAL ENERGY COST

Baseline (2013): $38,300

Actual (2016): $19,200

Expected Savings: $19,100

Other Benefits

POST RETROFIT IMPACT

Gladys Gardens is now a desirable place to live

No more heat and hot water complaints

Reduced resident turnover

SURVEY RESULTS 4 MONTHS POST RETROFIT

Residents reported increased comfort

Homes warmer with fewer drafts

Able to sleep better

Easier to breathe

Can identify trip hazards better due to improved lighting

New windows greatly reduced outside noise as well as reduced drafts

EPA

Hempstead Housing Authority

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RESOURCES

- Multifamily Retrofit Tools and Workforce Resources: https://energy.gov/eere/wipo/multifamily-retrofit-tools-and-workforce-resources
- ENERGY STAR for existing multifamily housing: https://www.energystar.gov/buildings/owners_and_managers/existing-buildings/find_resources_your_property_type/energy_star_multifamily_housing
- DOE study, The Health Benefits of Home Performance (includes section on ventilation): https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Home%20Rx%20The%20Health%20Benefits%20of%20Home%20Performance%20-%20A%20Review%20of%20the%20Current%20Evidence.pdf
- Standard Work Specifications for Multi-Family Home Energy Upgrades (includes chapter on Ventilation) https://sws.nrel.gov/sites/default/files/sws_multifamily.pdf
- ASHRAE 62.2 2016, *Ventilation and Acceptable IAQ in Residential Buildings,* now covers MF units: https://ashrae.iwrapper.com/ViewOnline/Standard_62.2-2016

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