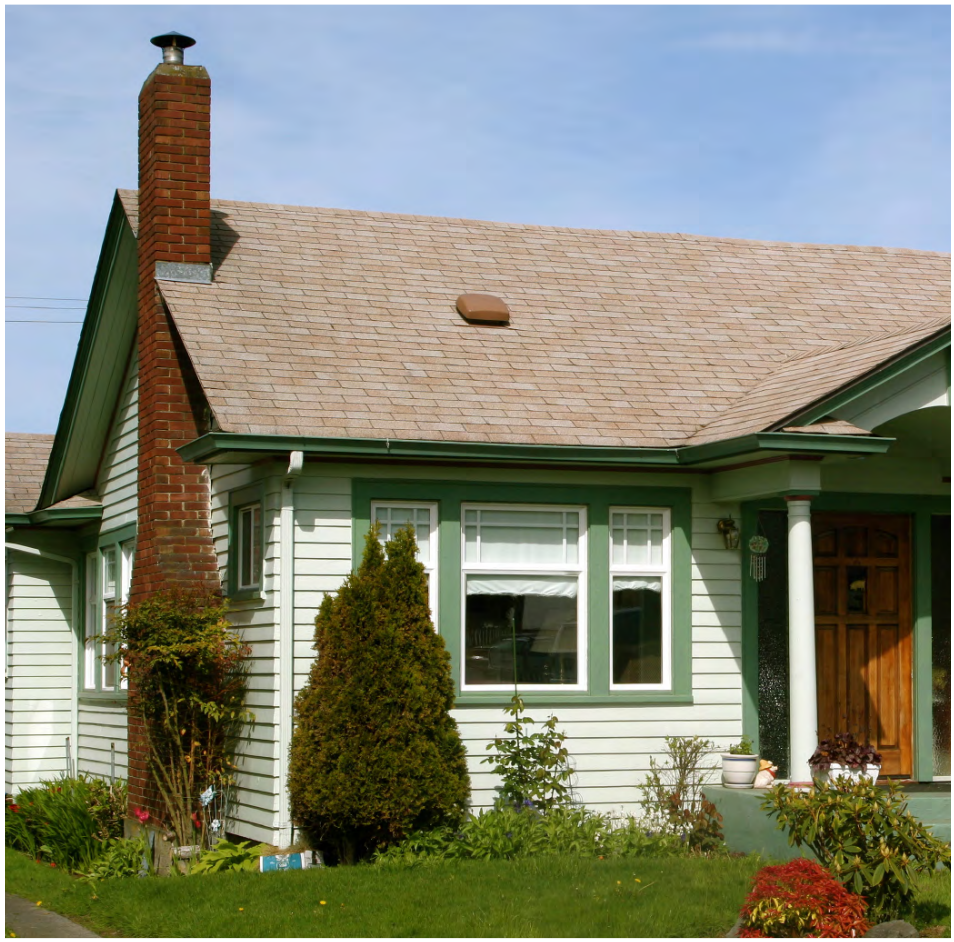
EPA
United States
Environmental Protection
Agency

Healthy Indoor Environment Protocols for Home Energy Upgrades



GUIDANCE FOR ACHIEVING SAFE AND HEALTHY INDOOR ENVIRONMENTS DURING HOME ENERGY RETROFITS

HEALTHY INDOOR ENVIRONMENT PROTOCOLS FOR HOME ENERGY UPGRADES

Purpose and Scope

Millions of American homes will be retrofitted in the coming years to improve their energy efficiency, make them more "green" or add features their owners want. Integrated healthy home and energy-efficiency retrofit activities can simultaneously lower utility costs and improve indoor air quality. Leading energy-efficiency retrofit programs have demonstrated the feasibility of integrating many indoor air quality and safety improvements. However, home energy retrofit activities might negatively affect indoor air quality if the appropriate home assessment is not made before work begins and issues that may affect indoor air quality are not identified and properly addressed. The U.S. Environmental Protection Agency (EPA) developed **Healthy Indoor Environment Protocols for Home Energy Upgrades** to provide practical guidance on improving or maintaining indoor air quality and indoor environments during home energy upgrades, retrofits or remodeling.

The protocols apply to existing single-family and multi-family low-rise residential buildings. They provide guidance for conducting home assessments and undertaking the responses necessary to maintain or improve indoor air quality and safety. The protocols also can help improve the quality of home weatherization projects and other energy-efficiency retrofit or remodeling jobs, thus reducing failures and call-backs.

The protocols are intended for use by the home energy retrofit industry, including energy-efficiency retrofit and housing rehabilitation professionals and contractors, and others engaged in energy-focused residential retrofit, renovation or remodeling efforts. They are also intended for voluntary adoption by federal, state, tribal and local weatherization assistance programs, federally funded housing programs, industry standards organizations, private sector home performance contracting organizations and public and environmental health professionals.

EPA developed these voluntary protocols in coordination with the U.S. Department of Energy (DOE) Workforce Guidelines for Home Energy Upgrades (http://www.weatherization.energy.gov/retrofit_guidelines) and the White House Council on Environmental Quality (CEQ) Recovery Through Retrofit initiative (http://www.whitehouse.gov/sites/default/files/Recovery_Through_Retrofit_Final_Report.pdf).

Programs and contractors undertaking energy retrofits and renovations are encouraged to coordinate their services with local health and housing resources to provide families the support they may need.

This document is not intended to 1) set new EPA regulatory standards, 2) provide guidance on diagnosing occupant health problems or building-related illness, 3) address emerging issues that have not been linked to adverse health effects, 4) make training or training documents unnecessary, 5) provide detailed guidance on how to achieve the intent of each recommendation in all situations or 6) identify funding availability or which programmatic funding sources should be used.

How the Protocols Are Organized

This document is organized into four sections to highlight priority indoor environmental issues that may relate to home energy-efficiency retrofits.

1. **Priority Issues** are listed in Column 1.
2. The **Assessment Protocols** in Column 2 are EPA-recommended or EPA-required protocols for evaluating existing conditions of concern and the potential for additional concerns that may arise from retrofit activities.
3. The **Minimum Actions** in Column 3 include critical actions that home energy retrofit contractors should take to help ensure their work does not introduce new indoor air quality concerns or make existing conditions worse. These actions often refer to national standards and guidance; however, work should be conducted in compliance with state and local requirements as well. All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.
4. The **Expanded Actions** in Column 4 include additional actions to promote healthy indoor environments that can be taken during many home energy retrofit projects. They can be performed by properly trained home energy retrofit workers who have sufficient resources. National standards and guidance are also referenced; however, work should be conducted in compliance with state and local requirements as well. All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.

Relevant standards and guidance documents are listed in the Assessment Protocols, Minimum Actions and Expanded Actions columns for each priority issue in an abbreviated format that can be identified with more detailed information in the References section.

The icons used in these protocols are:

Indicates an issue where worker safety is a primary concern. See **Appendix A: Worker Protection** for information on assessing the risks to workers, recommended actions to minimize risks to workers' health and safety and additional resources.

Indicates an issue where occupant education is especially important. If the icon appears in a priority issue section, appropriate occupant education about health and safety is strongly recommended as part of the retrofit activities. See **Appendix B: Client Education** for recommended occupant health messages and additional resources.

Contents

HEALTHY INDOOR ENVIRONMENT PROTOCOLS FOR HOME ENERGY UPGRADES

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
	Measures to help home energy retrofit contractors identify common indoor air quality and safety concerns in homes. This document is not a guide to diagnosing occupant health problems or building-related illnesses.	Critical actions intended to ensure work does not potentially cause or worsen indoor air quality or safety problems for occupants or workers (i.e., "Do No Harm"). EPA recommends these protections for ALL retrofit projects.	Additional actions to promote healthy indoor environments that can be taken during energy-efficiency retrofit projects. EPA recommends considering these improvements when feasible.
CONTAMINANTS			
ASBESTOS			
	Determine potential asbestos hazard. Consider the age of the structure; homes built after 1930 and before the 1970s especially may have asbestos insulation. Asbestos may also be present in other building materials in homes built or renovated prior to the 1990s. ***Note*** *Possible sources of asbestos are:* • *Attic insulation (especially vermiculite).* • *Wall insulation (e.g., vermiculite, insulation blocks).* • *Insulation on steam pipes, boilers and furnace ducts.* • *Vinyl flooring (including 9-inch by 9-inch or 12-inch by 12-inch floor tiles, vinyl sheet flooring and the mastics and other adhesives used to secure the flooring).* • *Cement sheet, millboard and paper used as insulation around furnaces and wood- or coal-burning appliances.* • *Door gaskets in furnaces and wood- or coal-burning appliances (seals may contain asbestos).* • *Soundproofing or decorative surface materials sprayed on walls or ceilings, including popcorn ceilings.* • *Patching and joint compounds and textured paints on walls and ceilings.* • *Roofing, shingles and siding (including cement or adhesives).* • *Artificial ashes and embers (used in gas-fired fireplaces).* • *Transite (cement and asbestos) combustion vent or transite flue.* • *Original plaster or plaster that is old enough to potentially contain asbestos.*	If suspected asbestos-containing material (ACM) is in good condition, do not disturb. If suspected ACM is damaged (e.g., unraveling, frayed, breaking apart), immediately isolate the area(s). For example, separate work area in question from occupied portions of the building using appropriate containment practices AND do not disturb. For suspected ACM that is damaged or that must be disturbed as part of the retrofit activity, contact an asbestos professional for abatement or repair, in accordance with federal, state and local requirements. Only a licensed or trained professional may abate, repair or remove ACM.  ***Note*** *Typically, trained professionals can repair asbestos by:* • *Sealing or Encapsulating: Treating the material with a sealant that either binds the asbestos fibers together or coats the material so fibers are not released. Pipe, furnace and boiler insulation can often be repaired this way.* • *Covering or Enclosing: Placing a protective layer over OR around the ACM to prevent release of fibers. Exposed insulated piping may be covered with a protective wrap or jacket.* • *Removing: Removing ACM may be advantageous when remodeling OR making major changes to a home that will disturb ACM, or if ACM is damaged extensively and cannot be otherwise repaired (by covering, enclosing, sealing or encapsulating).*	This cell is intentionally blank.

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ASBESTOS *(continued)*

ASSESSMENT PROTOCOLS

If unsure whether material contains asbestos, contact a qualified asbestos professional to assess the material. Sample and test as needed.

Note
The EPA vermiculate guidance referenced below includes photos to aid the identification of vermiculite insulation.

Relevant Guidance/Standards
The National Institute of Standards and Technology (NIST) maintains a list of asbestos laboratories accredited under the National Voluntary Laboratory Accreditation Program (NVLAP):

- Call NIST at (301) 975-4016 or email NVLAP@nist.gov.
- NIST/NVLAP: Accredited Laboratories for the Polarized Light Microscopy (PLM) Test Method.
- NIST/NVLAP: Accredited Laboratories for the Transmission Electron Microscopy (TEM) Test Method.

DOL, OSHA, 29 CFR Part 1926, subpart Z.

EPA Asbestos: Asbestos in Your Home.

EPA Asbestos: Regional and State Asbestos Contacts.

EPA Vermiculite.

If working in a pre-1980 building, see: Appendix A: Worker Protection – Asbestos and Confined Spaces.

Minimum Actions

When working around ACM, do not:

- Dust, sweep or vacuum ACM debris.
- Saw, sand, scrape or drill holes in the material.
- Use abrasive pads or brushes to strip materials.

Do not remove OR disturb attic insulation that looks like vermiculite unless the material has been tested and found not to contain asbestos.

Any asbestos abatement or repair work should be completed prior to blower door testing. Exercise appropriate caution when conducting blower door testing where friable asbestos or vermiculite attic insulation is present to avoid drawing asbestos fibers into the living space (i.e., use positively pressurized blower door testing) unless the material has been tested and found not to contain asbestos.

Notes
Appropriate identification of ACM is necessary to ensure the continued safety of the occupants and the safety of workers, who may not be aware of asbestos hazards.

If ACM may be disturbed during a planned retrofit, a competent person needs to conduct an initial exposure assessment to determine potential worker exposures and required exposure controls.

Asbestos awareness training is recommended for retrofit workers, especially auditors and crew chiefs.

Relevant Guidance/Standards
BPI Technical Standards: Technical Standards for the Heating Professional.

DOL, OSHA, Asbestos.

DOL, OSHA, Asbestos – Construction.

EPA Asbestos: Asbestos in Your Home.

EPA Vermiculite.

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
BELOWGROUND CONTAMINANTS (except radon)	Visually evaluate potential sources AND check for odors of gasoline, sewer gas or fuel oil. Visually evaluate the integrity of sewer vent system (e.g., ensure drain traps have water in them, inspect drain lines for breaks or leaks), particularly if there is the odor of sewer gas in the home (e.g., during the initial assessment or a fan depressurization test). If you detect an odor but cannot identify its source and the house is in a known contaminated area, notify local or state authorities AND/OR pursue additional assessment before making additional energy upgrades. If soil or groundwater contamination is suspected on or near the building site (e.g., former industrial site), volatile contaminants or breakdown products may pose an indoor air quality risk through soil gas intrusion. In such cases, EPA recommends further assessment before air sealing. Consult your state OR tribal voluntary brownfield cleanup program OR environmental regulatory agency for information on the risks of vapor intrusion in your area. **Relevant Guidance/Standards** ASTM E2600. EPA OSWER Draft Guidance for Evaluating Vapor Intrusion.	Repair or replace failed or unattached sewer vent system components before proceeding with energy retrofits. If the assessments reveal sewer gas odors from drain traps that are dry due to infrequent use, fill the traps with a non-toxic liquid that has a slow evaporation rate (e.g., mineral oil). If soil gas vapor intrusion is suspected, assess AND mitigate in compliance with state or local standards. If there are no such standards, follow EPA guidance, below, for vapor intrusion evaluation and mitigation. ***Note*** *The causes or sources of contaminants must be identified and corrected before air sealing or other weatherization retrofit actions are performed to ensure the problem is not exacerbated.* **Relevant Guidance/Standards** ASPE Data Book. Conduct work in compliance with state and local standards. Otherwise follow: ASTM E2600. EPA OSWER Draft Guidance for Evaluating Vapor Intrusion. EPA Vapor Intrusion Mitigation Approaches.	If there is an untrapped floor drain, consider installing a low-cost floor drain seal like those often used during radon mitigations, as described in ASTM E2121. **Relevant Guidance/Standards** ASTM E2121.

BUILDING PRODUCTS/ MATERIALS EMISSIONS

Review information on the contents of products being considered for purchase and installation during an energy upgrade project to determine whether they contain potentially hazardous compounds. Many of these products and materials (e.g., paints, particle board, pressed wood, insulation, sealants, plywood and cleaning supplies) may contain volatile organic compounds (VOCs), including formaldehyde, or other hazardous compounds to which exposure should be minimized or eliminated during and after an energy upgrade.

Assess ventilation to determine compliance with the Minimum Actions and Whole-House Ventilation for Distributed Contaminant Sources (page 22).

Note:
Dilution using whole-house ventilation will help reduce VOCs and other airborne contaminants from indoor sources in most homes.

In most circumstances, testing for VOCs is not necessary. If odors or occupant complaints indicate potential VOCs or other airborne contaminants, follow the source control and ventilation actions under Minimum Actions and Expanded Actions.

If working with materials associated with chemical emissions or dust generation, including spray polyurethane foam insulation, see Jobsite Safety (page 24) and Appendix A: Worker Protection.

Relevant Guidance/Standards
American Chemistry Council: Spray Polyurethane Foam Health and Safety.

DOL, OSHA, Green Jobs Hazards.

EPA SPF: Spray Polyurethane Foam, Building Occupants and Other Workers Should Vacate During SPF Installation.

Whole-House Ventilation for Distributed Contaminant Sources (page 22).

Minimize occupant and worker exposure to VOCs or other airborne contaminants by:

- Ensuring that work areas are properly isolated (e.g., by sealing with plastic sheeting) and ventilated to the outdoors during activities that result in VOC emissions (e.g., installing spray foam insulation, painting, sealing, finishing) AND that they are ventilated as close as possible to the source of those emissions.
- Using appropriate dust-control and protective equipment.
- Thoroughly cleaning work areas and allowing any odors to dissipate before re-occupancy.
- Following manufacturers' recommendations, which may indicate the need to evacuate building occupants and other unprotected individuals from work areas during and for some period after the use of a product.

Source Control
When installing new products and materials, consider using the least toxic product or material feasible to effectively do the job. For example, use products and materials that indicate they have (or are certified as having) low VOC content or low VOC emissions.

Note:
California Title 17 requires reduced formaldehyde emissions from composite wood products and finished goods that contain composite wood products sold, offered for sale, supplied, used or manufactured for sale in California.

Ventilation
Ensure the home meets the Minimum Actions in the Whole-House Ventilation for Distributed Contaminant Sources section (page 22).

Ventilate the building with as much outside air as possible before permanently occupying. Do not conduct a "bake-out" in an attempt to reduce VOC emissions after the building is occupied, because it may cause VOCs to be absorbed by other interior materials and may damage building components.

New Products Source Control
When available, specify products and materials that meet independent certification and testing protocols, such as:

- California Department of Public Health, Emission Testing Method for California Specification 01350.
- Carpet and Rug Institute (CRI) Green Label or Green Label Plus program criteria or equivalent standards for carpet.
- Collaborative for High Performance Schools (CHPS) High Performance Products Database.
- Green Seal Standard GS-11.
- Greenguard Children and Schools Certification Program.
- Master Painters Institute (MPI) Green Performance Standards GPS-1 or GPS-2.
- Scientific Certification Systems (SCS) Standard EC-10.2-2007, Indoor Advantage Gold.

When installing structural plywood or pressed or composite wood products, select those that are certified compliant with California Title 17. If California Title 17 compliant materials are not available, use products that meet section 6.1 of EPA's Indoor airPLUS Construction Specifications.

Existing Condition Source Control/ Supplemental Ventilation
If odors, complaints or testing indicate potential VOCs or other airborne contaminants, remove any potential sources (e.g., hobby materials, fiberglass that may contain formaldehyde) from the room or area. If removal is not feasible, consider installing local exhaust ventilation for sources that are isolated in a specific room or area.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
BUILDING PRODUCTS/ MATERIALS EMISSIONS *(continued)*			
		Relevant Guidance/Standards American Chemistry Council: Spray Polyurethane Foam Health and Safety. California Title 17. EPA SPF: Spray Polyurethane Foam. Whole-House Ventilation for Distributed Contaminant Sources (page 22).	Seal composite wood products (e.g., particle board and pressed wood) that are not compliant with California Title 17 or that do not meet section 6.1 of EPA's Indoor airPLUS Construction Specifications with a sealant intended to reduce VOC emissions. Seal all exposed surfaces and holes, as appropriate. Check with vendors for recommendations on sealing their engineered wood products. If these actions do not solve the problem (e.g., persistent odors, occupant complaints), hiring an environmental professional and testing may be necessary. **Testing** If VOCs appear to be present based on odors or complaints and source control or ventilation do not alleviate the problem, testing by a qualified professional may be useful. **Relevant Guidance/Standards** California Department of Public Health, Emission Testing Method for California Specification 01350. California Title 17. CARB: Formaldehyde. CHPS. CRI. EPA Design for the Environment. EPA Indoor airPLUS Specification Section 6. Green Seal Standard GS-11. Greenguard Children and Schools Certification Program. MPI GPS-1 and GPS-2. SCS Standard EC-10.2-2007. Whole-House Ventilation for Distributed Contaminant Sources (page 22).

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
CARBON MONOXIDE (CO) AND OTHER COMBUSTION APPLIANCE EMISSIONS (NITROGEN OXIDES, VOLATILE ORGANIC COMPOUNDS [VOCs] AND PARTICULATES)			
	Locate and identify any fuel-burning combustion appliances in the home (e.g., gas, oil, kerosene, wood- or coal-burning appliances). See Combustion Safety (page 18) and Wood Smoke and Other Solid Fuel Emissions (page 16) for assessment protocols to complete safety inspections of all combustion appliances in a dwelling. Determine if there is an attached garage. See Garage Air Pollutants (page 8) for ways to locate air leaks from a garage to occupied spaces. Determine whether there are working carbon monoxide (CO) alarms and smoke alarms. Ask occupants whether they have supplemental portable combustion equipment (e.g., generators, unvented gas or kerosene space heaters). Test interior living space for CO. Avoid testing near combustion equipment that has already undergone CO testing. Test for CO outside of the home (e.g., near front entrance) to document general outdoor levels. Avoid testing near obvious sources of CO (e.g., motor vehicles, lawn equipment). **Relevant Guidance/Standards** BPI-1100-T-2010, Combustion Appliance Testing section. Combustion Safety (page 18). Garage Air Pollutants (page 8). Wood Smoke and Other Solid Fuel Emissions (page 16).	If CO levels in interior living spaces exceed outdoor levels, investigate potential sources and take appropriate action to reduce them (e.g., have a qualified professional tune, repair or replace improperly operating combustion appliances; apply weatherstripping or conduct air sealing between the garage and the home). Specify and install CO alarms in all homes. See Home Safety (page 23) for details. See Garage Air Pollutants (page 8) for recommendations on how to minimize the movement of air and contaminants (including CO and other combustion appliance emissions) from the garage to the house. See Combustion Safety (page 18) and Heating, Ventilating and Air Conditioning (HVAC) Equipment (page 17), as appropriate, for recommendations on repairing, removing or replacing combustion appliances. **Relevant Guidance/Standards** Combustion Safety (page 18). Garage Air Pollutants (page 8). Heating, Ventilating and Air Conditioning (HVAC) Equipment (page 17). Home Safety (page 23).	See Home Safety (page 23) for recommended installation of CO alarms that can detect and store peak CO levels of less than 30 ppm. See the Expanded Actions for Garage Air Pollutants (page 8) for additional recommendations on minimizing airflow from the garage to the house. See the Expanded Actions for Combustion Safety (page 18) for additional recommendations on repairing, removing or replacing combustion appliances. **Relevant Guidance/Standards** Combustion Safety (page 18). Garage Air Pollutants (page 8). Home Safety (page 23).

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
ENVIRONMENTAL TOBACCO SMOKE (ETS)			

	Single Family Dwelling: Look for signs of smoking indoors (e.g., ashtrays, cigarette packs, odors).
	
	Multi-Family Dwelling: Determine whether there is a smoke-free housing policy. Determine whether tenants have complained about smoking odors or smoking related concerns.
		Single-Family Dwelling: See Appendix B: Client Education.
		
		Multi-Family Dwelling: If there have been complaints, ask the owner if a smoke-free housing policy is being considered. If a policy has not been adopted, address the complaints through the following actions:
		• Reduce unintended excess airflow from common exhaust ventilation systems due to duct and shaft leakage, excess fan flow and unbalanced unit flows.
		• Seal enough to enable ventilation systems to increase capture in smokers' units, match flows to remove fan-induced pressure difference between units, and increase outdoor air supply ventilation rates in non-smokers' units.
		• Reduce ETS transfer from smokers' units by:
		  • Air sealing the walls, ceilings and floors that separate the unit from neighboring units, corridors, chases and stairwells. Seal smoker's unit as tightly as possible.
		  • Adjusting outdoor air and exhaust flows so the unit is negative relative to bounding wall and ceiling cavities and the overall ventilation rate for the unit has increased. Smoke current tubes or other air flow tests should show that air flows into the dwelling unit through openings in bounding walls (e.g., electrical outlets).
		
		Note
		The above air sealing strategies are intended to help reduce the exposure of occupants in the non-smoking units adjacent to the smokers' units. These actions may not reduce the risks of ETS to occupants living in the smokers' units.
		
		Relevant Guidance/Standards
		ASHRAE 62.2-2010.
		
		MNCEE: Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments.
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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
ENVIRONMENTAL TOBACCO SMOKE (ETS) *(continued)*			
		NCHH Fact Sheet: Improving Ventilation in Existing or New Buildings with Central Roof Exhaust. NCHH Fact Sheet: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation Systems. NCHH Fact Sheet: Improving Ventilation in New and Existing Multi-Family Buildings with Individual Unit Ventilation Systems.	
GARAGE AIR POLLUTANTS (CO, BENZENE AND VOCS)			
	If there is an attached garage (i.e., sharing at least one wall, ceiling, ductwork, etc.), identify the location of any air leaks from the garage to the occupied spaces that may provide pathways for hazardous emissions to enter the occupied spaces. Look for leaks around walls, doors, ceilings, ductwork, air conditioners, furnaces, chimneys and electrical and pipe penetrations. Determine (visual inspection and/or occupant inquiry) if there are unvented combustion appliances or hobby equipment that may be used in the garage. ***Note*** *If combustion appliances are present, see Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6), Vented Combustion Appliances (page 18) and Unvented Combustion Appliances (page 20) for recommended actions.* **Relevant Guidance/Standards** Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). Energy Conservatory: Blower Door. Unvented Combustion Appliances (page 20). Vented Combustion Appliances (page 18).	To minimize the movement of air and contaminants from the attached garage to the house, air seal walls and ceilings separating the garage from the living spaces. At a minimum, air seal these locations (if present): • Doors (ensure tight closure AND install weather-stripping). • Electrical, plumbing and duct penetrations. • Cracks between mud sill, rim joists, subfloors and/or bottom of gypsum board. • Leaks in the ductwork and air handlers and gaps around the ductwork penetrating from the garage to the occupied space. To keep garage air from being drawn into the home, eliminate or disconnect supply diffusers and return grilles in the garage that connect to air handlers serving the occupied space. If heat is needed in the garage, use a properly installed supplemental heating system. **Relevant Guidance/Standards** ACCA 5 QI-2010. ASHRAE 62.2-2010.	Steps that can reduce air pressure in the garage and minimize flow from the garage to the house include the following: • If occupants spend significant time in the garage (e.g., the garage is used as a workshop or playroom), at a minimum, install local exhaust fan(s) rated for continuous operation and vented outdoors in attached garages in accordance with section 5.6 of EPA's Indoor airPLUS Construction Specifications or 2009 International Mechanical Code, table 403.3. • Relocate the air handling equipment and associated ductwork from the garage to an area within a conditioned space. • If accessible, add blocking in the floor system to assist with air sealing between the garage and living space in homes that have a room above the garage. • Use advanced blower door techniques (see guidance listed below) to identify air leakage pathways between the house and garage and to verify the effectiveness of air sealing. **Relevant Guidance/Standards** EPA Indoor airPLUS Specification 5.6. Home Energy, Advanced Blower Door Techniques. International Mechanical Code, 2009.

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
LEAD			
	Assume there is lead-based paint in homes built before 1978 unless testing shows otherwise. Determine whether paint will be disturbed by the work or the assessment. Consider using an EPA-recognized testing method (e.g., X-ray fluorescence [XRF] testing, or an on-site test kit) on suspect surfaces that will be disturbed in order to determine whether the paint is lead-based. The lead-safe work practices minimum and expanded actions apply only to paint assumed to be or tested to confirm that it is lead-based. **Relevant Guidance/Standards** HUD Title 24. EPA Renovation, Repair and Painting (RRP) Program Rule: 24 CFR Part 25, subpart J. EPA Lead. EPA Lead-Based Paint Renovation, Repair, and Painting Program: Small Entity Compliance Guide to Renovate Right. If working in a pre-1978 building, see Appendix A: Worker Protection – Lead. 	Comply with EPA's Lead-Based Paint Renovation, Repair, and Painting (RRP) Program Rule. Among the rule's key elements are: • Use a Certified Renovator. • Follow lead-safe work practices if disturbing more than 6 ft^2 of interior or 20 ft^2 of exterior painted surfaces. • Contain the work area to avoid resident exposure. • Minimize lead dust and leave no dust or debris behind. • Achieve visual post-cleaning criteria. Comply with state and local lead-related regulations, which may be applicable to lead hazard reduction activities and may require additional certified personnel. ***Note*** *This is not a complete summary of the regulatory requirements. The intent of this protocol is to promote the most health-protective steps that are feasible and practical. The minimum action recommended in this protocol is to comply with whatever the most current version of the RRP Program Rule prescribes.* **Relevant Guidance/Standards** DOL, OSHA, Lead. EPA Renovation, Repair and Painting (RRP) Program Rule: 24 CFR Part 25, subpart J. EPA Renovation, Repair and Painting (RRP) Program Rule: 40 CFR Part 745. EPA Lead Accredited Training Programs.	Follow the U.S. Department of Housing and Urban Development (HUD) lead-safe rehabilitation practices. In addition to EPA's RRP, these HUD practices: • Lower the thresholds for interior painted surface area from 6 ft^2 to 2 ft^2. • Require repair of painted surfaces that are disturbed when using lead-safe work practices. • Require meeting lead dust clearance testing standards if more than 2 ft^2 of paint is disturbed. ***Note*** *Lead dust clearance testing includes measuring for lead dust on floors, windowsills and window troughs. See NCHH Fact Sheet: Testing for Lead-Contaminated Dust.* **Relevant Guidance/Standards** EPA Renovation, Repair and Painting (RRP) Program Rule: 24 CFR Part 25, subpart J. HUD Lead Safe Work Practices. NCHH Fact Sheet: Testing for Lead-Contaminated Dust.
MOISTURE (MOLD AND OTHER BIOLOGICALS)			
	Inspect the interior and exterior of the building for evidence of moisture problems. Document the extent and location of the problems, and the proposed repairs, to avoid exacerbating the problems when the repairs are made. Examples of moisture and mold problems are: • Water damage or stains. • Foundation cracks that leak water. • Visible mold growth.	Repair roof leaks before air sealing or insulating the attic. Address surface water pooling near the foundation before insulating basement or crawlspace walls near wet areas.	Repair additional moisture problems identified during the assessment (e.g., plumbing leaks, rain leaks including leaks around windows and flashing, and foundation leaks). Retrofit crawlspaces so that they are unvented, sealed, insulated, properly drained and waterproofed, following guidance in section 1.4 of EPA's Indoor airPLUS Construction Specifications.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
MOISTURE (MOLD AND OTHER BIOLOGICALS) *(continued)*			

	• Wet or damp spots.
	• Musty odor.
	• Moisture damage on windows.
	• Groundwater, surface water and rainwater intrusion.
	• Plumbing leaks.
	• Condensation.
	• Consider temperature, relative humidity and absolute humidity (e.g., dew point temperature and humidity ratio [i.e., pounds or grains of water vapor per pound of dry air]).
	
	Determine whether the project requires mold remediation and additional moisture control measures (e.g., as determined during a Weatherization Assistance Program audit).
	
	Document which moisture problems will be addressed as part of the energy-conserving project, and which must be repaired by the homeowner or another contractor before certain, specific energy conserving measures can be implemented.
	
	If moisture issues cannot be addressed, do not install energy upgrades that will reduce the home's air infiltration rate. Homes where this may be the case include those that have significant condensation or humidity problems, such as condensation on multiple windows, condensation in attics or significant moisture or mold problems that are beyond the scope of the remedies under Minimum Actions.
	
	See Appendix A: Worker Protection – Mold and Confined Spaces as appropriate.
		Manage rainwater in assemblies receiving retrofits (e.g., drainage planes and flashings), following guidance in EPA's Indoor airPLUS Construction Specifications 1.5 and 1.6.
		
		Ensure proper HVAC condensate drainage.
		
		Prevent condensation in the enclosure by:
		• Air sealing the enclosure. *Note: This also prevents ice dams in cold, snowy climates.*
		• Managing water vapor flow and condensing surface temperatures to avoid dew point conditions (achieved by selection of materials with appropriate combination of R-value and vapor permeability).
		• Managing air pressure relationships as needed.
		• Controlling indoor humidity sources, for example:
		  • Ensuring bath fans are operating properly and vented to the outdoors.
		  • Ensuring clothes dryers are correctly vented to the outdoors.
		  • Covering earthen floors in basements and crawlspaces with sealed vapor barriers; seal sump crocks.
		  • If adding an air conditioning (AC) unit, ensure it is sized properly. If the relative humidity or moisture in the air is high, evaluate whether the AC unit is oversized.
		  • Install dehumidifiers, if appropriate.
		  • Remove unvented combustion space heaters.
		  • Ensure proper crawlspace ventilation.
		  • Ensure proper attic ventilation, unless sealed or conditioned.
		
		Conduct any required mold remediation following EPA or other professional guidance (see see Appendix A, Mold section, page 34).
		
		See Mold and Moisture section in Appendix B: Client Education.
			Perform additional activities, beyond those required for the weatherization project, in order to remediate any mold growth. Follow EPA or other professional guidance (see Appendix A, Mold section, page 34).
			
			Relevant Guidance/Standards
			EPA Indoor airPLUS Specification: 1.4.
			
			EPA Mold Remediation.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
MOISTURE (MOLD AND OTHER BIOLOGICALS) *(continued)*			
	Relevant Guidance/Standards DOE: Workforce Guidelines for Home Energy Upgrades (under development).	***Notes*** *Replacing an atmospherically vented or fan-powered combustion device that draws combustion air from inside the home with a high-efficiency sealed combustion device can reduce the ventilation rate, which could result in cold-weather condensation in some building enclosures.* *If an atmospherically vented combustion device is causing an indoor humidity problem, it should be repaired in accordance with the Combustion Safety section (page 18).* **Relevant Guidance/Standards** Combustion Safety (page 18). DOE: Workforce Guidelines for Home Energy Upgrades (under development). EPA Indoor airPLUS Specifications 1.5 and 1.6.	
OZONE			
	Determine if there is any air-cleaning equipment designed to intentionally produce ozone (i.e., ozone generators) in the house. **Relevant Guidance/Standards** CARB: Ozone.	Do not install air-cleaning equipment designed to intentionally produce ozone (i.e., ozone generators). Recommend removal of air-cleaning equipment designed to intentionally produce ozone, if present. **Relevant Guidance/Standards** EPA Indoor airPLUS Specification 4.7. EPA IAQ: Ozone Generators that are Sold as Air Cleaners.	This cell is intentionally blank.
PESTS			
	Identify evidence of mice, squirrels or other rodents; termites; birds; bats; cockroaches or other pests. Note the location and identify pest-contaminated materials (e.g., nests, feces). Determine whether rodenticides or pesticides are being used. Remove pest-infested materials OR determine if professional assistance is needed to do so before conducting energy retrofit work in pest-infested areas.	Alert owner of any termite infestations and inform owner of the need to seek assistance from an integrated pest management (IPM) professional (e.g., Greenpro, Greenshield or equivalently trained IPM professional). In areas with evidence of rodent infestations, patch with pest-resistant materials (e.g., copper mesh, hardware cloth, sheet metal, concrete) exterior holes that are larger than ¼ inch by ⅜ inch before applying air sealing materials (e.g., caulk or foam) OR before insulating.	Protect air intakes from potential bird and pest entry (e.g., cover openings with ½-inch screen or galvanized mesh). Protect exhaust vents from rodent, bird and pest entry (e.g., cover openings with louvers). Avoid creating conditions that can clog exhaust, particularly dryer vents.

(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
PESTS *(continued)*	***Note*** *Termite and some other types of pest infestations are often an indication of moisture problems. See Moisture (page 9) for diagnosing moisture problems.* **Relevant Guidance/Standards** AFHH. CDC Resource on Rodents.	Advise owner/resident to regularly clean/fix screens or dampers over exterior air intakes and exhausts (e.g., at least semi-annually or when replacing HVAC filters). Remove clutter, eliminate wood piles near house, and remove bushes, trees or other vegetation closer than two feet from the structure.  **Relevant Guidance/Standards** EPA IPM. NCHH IPM. New York City Department of Health and Mental Hygiene.	Follow IPM guidelines for roach control AND, if feasible, apply boric acid or gels in holes for roach issues. Follow relevant state pesticide applicator standards. ***Note*** *Some states require that pest management professionals be licensed.* Provide sealable outside garbage cans OR advise clients to use them. **Relevant Guidance/Standards** ASHRAE 62.2-2010. EPA IPM. New York City Department of Health and Mental Hygiene.
POLYCHLORINATED BIPHENYLS (PCBs)	Determine whether fluorescent light ballasts containing polychlorinated biphenyls (PCBs) are present. ***Note*** *Some homes may contain fluorescent light fixtures with ballasts manufactured before 1979 that contain polychlorinated biphenyls (PCBs). Ballasts manufactured between 1979 and 1998 that do not contain PCBs were required to be labeled "No PCBs." Newer fluorescent lighting typically uses electronic ballasts that do not contain PCBs and should be clearly marked as electronic.* **Relevant Guidance/Standards** EPA PCB-Containing Light Ballasts.	If fluorescent light ballasts do not have the statement "No PCBs" or are not marked as electronic, assume that the ballasts contain PCBs and replace with new lighting fixtures OR contact the manufacturer to determine whether the ballasts contain PCBs. If the manufacturer is not sure whether the ballasts contain PCBs, assume that they do and replace with new lighting fixtures. **Relevant Guidance/Standards** EPA PCB. EPA PCB-Containing Light Ballasts.	The presence of PCBs may not be limited to fluorescent light ballasts. PCBs were also used in other products, including caulk. See EPA's website on PCBs for a complete list of products of concern, and where possible, remove and replace them. **Relevant Guidance/Standards** EPA PCB. EPA PCBs in Caulk.
RADON	Follow one of two testing options to determine the radon level as summarized below and in Table 1. **Option 1: Test-In/Test-Out** – Test for radon before and after energy upgrade work. **Option 2: Post-Work Test** – Test for radon only after completing energy upgrade work.	Before completing retrofit activities, take precautionary measures listed below in Column 1 of Table 1, depending on pre-work test results. After work, follow the appropriate Minimum and/or Expanded Actions outlined in Table 1, depending on post-work test results.	Additional actions to reduce radon exposure are summarized below and outlined in Table 1. • Mitigate according to ASTM E2121 when the post-work radon level is ≥ 4 pCi/L. • If the post-work radon level is between 2 and 4 pCi/L, refer the client to EPA's Citizen's Guide to Radon or mitigate in accordance with ASTM E2121.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
RADON *(continued)*			

Perform radon testing in accordance with applicable state requirements or federal guidance. Individuals conducting tests should be trained or certified by either of these groups:

- National Environmental Health Association (NEHA) National Radon Proficiency Program.
- National Radon Safety Board (NRSB).

Notes

Two radon tests may be performed simultaneously and averaged to increase confidence in the short-term test result. This approach can be used for both pre- and post-work testing. Another option is to take two tests sequentially. DO NOT average the pre-work and post-work test results.

Long-term testing is the most accurate way to test for radon, but it may not be feasible. See EPA's Citizen's Guide to Radon for information on long-term testing.

The recommended testing protocols are designed to ensure that radon exposure does not increase above EPA thresholds in homes where radon levels are initially below those thresholds. This protocol is not designed to mitigate radon risks that existed prior to the energy upgrade. All clients should be provided with radon testing results.

Determine whether the home has an active or passive radon mitigation system.

Note

Active mitigation systems include a radon vent fan, usually located in an attic, in an attached garage or on the building exterior.

Relevant Guidance/Standards

ASHI Radon Mitigation System Inspection Checklist.

EPA Radon Guidance: Guidance for Radon Testing and Mitigation.

EPA Radon: State Radon Contact Information.

When the pre-work radon level is ≥ 2 pCi/L, complete precautionary foundation air sealing strategies:

- Cover exposed earthen floors in basements and crawlspaces according to section 1.2 of EPA's Indoor airPLUS Construction Specifications.
- Air seal sumps (e.g., install an airtight sump cover) in such a way that water can drain from above and below the sump cover.
- Install airtight drain fittings (e.g., trap or flange system) in foundation floor drains.
- Seal and caulk penetrations, openings or cracks in below-grade walls and floors that contact the ground with a sealant that meets the requirements of ASTM C920.

Note

These foundation air sealing strategies are also important elements of radon mitigation according to ASTM E2121, which addresses both foundation air sealing and fan-powered radon mitigation systems.

Educate the client about the test results and radon reduction measures that were followed. Inform the client that the radon testing protocols were completed to ensure that the energy upgrade work did not introduce indoor radon problems, but the protocols do not necessarily mitigate a prior indoor radon problem in the home. Advise the client to refer to EPA's Citizen's Guide to Radon for more information about radon risk.

Mitigate in accordance with ASTM E2121 if:

- Option 1: Post-work radon level is ≥4pCi/L AND it exceeds the pre-work radon level OR
- Option 2: Post-work radon level is ≥4pCi/L AND no pre-work levels were taken.

Relevant Guidance/Standards

ASTM C920.

ASTM E2121.

EPA Radon. State Radon Contact Information.

EPA Radon Guidance: Citizen's Guide to Radon.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
RADON *(continued)*		For homes equipped with an active radon mitigation system: • Verify that the radon vent fan is operating. • If a previously installed radon mitigation system is not operating correctly OR if the post-work tested radon level is ≥4 pCi/L, advise the client to consult the state radon office. **Relevant Guidance/Standards** ASTM C920. ASTM E2121. EPA Indoor airPLUS Specification 1.2. EPA Radon Guidance: Citizen's Guide to Radon.	

Table 1: Radon Testing Options and Reduction Strategies

Pre-Work Test Result and *Precautionary Measures*	Post-Work Test Result	Minimum Actions	Expanded Actions
<2 pCi/L *Consider precautionary radon-reduction actions as part of energy upgrade work, especially covering exposed earth, air sealing open sumps, ensuring floor drains have traps and that traps are not dry.*	<2 pCi/L	No action.	
	>2 and <4 pCi/L	Complete foundation air sealing strategies.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	≥4 pCi/L ≥4 pCi/L	Mitigate in accordance with ASTM E2121.	
>2 and <4 pCi/L *Take precautionary radon-reduction actions: complete foundation air sealing strategies as part of energy upgrade work.*	<4 pCi/L and NOT higher than pre-work level.	No further minimum action.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	<4 pCi/L AND higher than pre-work level.	Verify that foundation air sealing strategies were completed appropriately and correct deficiencies.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	≥4 pCi/L	Mitigate in accordance with ASTM E2121.	
≥4 pCi/L *Complete all foundation air sealing strategies as part of energy upgrade work.*	<4 pCi/L	No further minimum action.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumer's Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	≥4 pCi/L but NOT higher than pre-work level.	Refer client to EPA's Citizen's Guide to Radon and recommend radon mitigation.	Mitigate in accordance with ASTM E2121.
	≥4 pCi/L AND higher than pre-work level.	Mitigate in accordance with ASTM E2121.	
No Pre-Work Test *Consider precautionary radon-reduction actions as part of energy upgrade work, especially covering exposed earth, air sealing open sumps, ensuring floor drains have traps and that traps are not dry.*	<4 pCi/L	No further minimum action.	For post-work radon levels between 2 and 4 pCi/L, refer client to EPA's Citizen's Guide to Radon and Consumers Guide to Radon Reduction and/or mitigate in accordance with ASTM E2121.
	≥4 pCi/L	Mitigate in accordance with ASTM E2121.	

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
WOOD SMOKE AND OTHER SOLID FUEL EMISSIONS			
	Determine whether there are wood- or coal-burning appliances (e.g., wood stove or furnace, wood pellet stove, fireplace) in the home. If wood- or coal-burning appliances are present, determine whether there is evidence of wood smoke emissions affecting the home, using any of the following practices or the equivalent (note that many of the following may require input from certified/trained professionals): • Look for evidence of soot on the walls or ceiling or creosote staining near the flue pipe. • Determine whether the inside of the home smells like wood smoke. • Ask occupants whether they regularly (i.e., daily) smell wood smoke during the heating season. • If certified/trained professionals are available, consider using a particle counter to quantify particulates in the indoor air. Assess appliance safety by considering: • Appliance condition, especially leaks, cracks or faulty flue connections. • Proper distance of appliance to combustible materials (minimum clearances) and/or proper protection of combustibles. • Proper size and materials of floor protection. • Proper venting system (Vented Combustion Appliances [page 18] and Unvented Combustion Appliances [page 20]). Determine whether the wood- or coal-burning appliance is EPA-certified (i.e., more energy efficient and cleaner burning). Determine whether a hydronic heater (e.g., outdoor wood-fired boiler) is present. If the wood- or coal-burning appliance is operating during the assessment, observe the opacity of the smoke leaving the chimney.	Assess what the proper size of any wood- or coal-burning appliances will be after the retrofit is complete. If the current unit is oversized, recommend replacement with a properly sized, EPA-certified appliance. If evidence of soot, wood smoke or other health safety concern is apparent, determine the source of the problem and work with the appropriate certified professional (e.g., NFI, CSIA, etc.) to resolve it. Encourage the homeowner to have a certified professional chimney sweep (e.g., certified by the Chimney Safety Institute of America) inspect the chimney and wood- or coal-burning appliance annually. Share EPA Burn Wise tips with the homeowner: http://www.epa.gov/burnwise/pdfs/BurnWiseTips.pdf. **Relevant Guidance/Standards** CSIA. EPA Burn Wise Guides: Burn Wise Guide for Best Burn Practices for Wood Stoves. EPA Burn Wise Tips. NESCAUM Regulations. NFPA 211.	Replace non-certified wood- or coal-burning appliances with properly sized and installed EPA-certified wood- or coal-burning appliances after the retrofit is complete. Appliances should be installed according to the manufacturer's instructions. **Relevant Guidance/Standards** EPA Burn Wise Lists.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
WOOD SMOKE AND OTHER SOLID FUEL EMISSIONS *(continued)*			
	Note *One hundred percent opacity means nothing can be seen through the smoke. At 20% opacity, there is very little smoke and you can see almost completely through it. Smoke with opacity of more than 20% is an indication that unseasoned wood is being burned, a non-EPA approved stove is in use or poor operation.* **Relevant Guidance/Standards** EPA Burn Wise Guides: Burn Wise Guide for Identifying Cleaner-Burning Appliances. Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). NFPA 211. Unvented Combustion Appliances (page 20) Vented Combustion Appliances (page 18)		
CRITICAL BUILDING SYSTEMS FOR HEALTHY INDOOR ENVIRONMENTS			
HEATING, VENTILATING AND AIR CONDITIONING (HVAC) EQUIPMENT			
	Evaluate the condition of the existing HVAC system components (e.g., furnace, boiler, air handler, heat pump, associated ductwork) in accordance with minimum inspection standards of ANSI/ACCA Standard 4 (Maintenance of Residential HVAC Systems), ASHRAE handbooks or other equivalent standards and guidelines. Ventilation requirements are also addressed in Source Ventilation (page 21), Whole-House Ventilation for Distributed Contaminant Sources (page 22) and Multi-Family Ventilation (page 22). The HVAC assessment is to include an evaluation of whether the system is functioning properly, based on ANSI/ACCA checklists appropriate for the type of equipment. Determine whether the HVAC system is properly sized in accordance with ASHRAE handbook, or other equivalent standardized guidelines.	Based on an assessment of equipment condition and sizing, repair, modify or replace equipment to meet minimum corrective actions for proper HVAC function. If repairs are needed to restore HVAC to proper functioning, repair in accordance with ANSI/ACCA Standard 6 (Restoring the Cleanliness of HVAC Systems), ASHRAE handbooks or other equivalent standards and guidelines. If replacing equipment, base sizing calculations on post-retrofit conditions. Refer to Sections 4.1 and 4.2 of EPA Indoor airPLUS Construction Specifications. Install new equipment in accordance with ANSI/ACCA Standard 5 (HVAC Quality Installation Specification) AND verify installation in accordance with ANSI/ACCA Standard 9 (HVAC Quality Installation Verification Protocols), ASHRAE handbooks or other equivalent standards and guidelines.	Replace functioning HVAC equipment that is near the end of its service life with new energy-efficient HVAC equipment and base sizing calculations on post-retrofit conditions. Refer to Sections 4.1 and 4.2 of EPA Indoor airPLUS Construction Specifications. Follow ANSI/ACCA Standard 5 (HVAC Quality Installation Specification), Standard 9 (HVAC Quality Installation Verification Protocols), ASHRAE handbooks or other equivalent standards and guidelines. Consider using filters with a high MERV rating (11 or above) if equipment capacity is sufficient to accommodate the pressure drop. For existing systems, check with the manufacturer to determine whether MERV 11 filters can be installed.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
HEATING, VENTILATING AND AIR CONDITIONING (HVAC) EQUIPMENT *(continued)*			
	If HVAC replacement or modification is anticipated, base sizing calculations on post-retrofit conditions. Refer to Sections 4.1 and 4.2 of EPA Indoor airPLUS Construction Specifications. **Relevant Guidance/Standards** ACCA 4 QM-2007. ASHRAE Handbooks: ASHRAE Handbook Series. EPA Indoor airPLUS Specifications: 4.1 and 4.2. Multi-Family Ventilation (page 22). Source Ventilation (page 21). Whole-House Ventilation for Distributed Contaminant Sources (page 22).	Ensure newly installed central forced-air HVAC systems have a minimum MERV 6 filter, no filter bypass, and no air cleaners designed to intentionally produce ozone. **Relevant Guidance/Standards** ACCA 5 QI-2010. ACCA 6 QR-2007. ACCA 9 QIVP-2008. ASHRAE 62.2-2010, Section 6.7. ASHRAE Handbooks: ASHRAE Handbook Series. ASHRAE 52.2-2007. EPA Indoor airPLUS Specifications: 4.1, 4.2 and 4.7. EPA IAQ: Residential Air Cleaners.	**Relevant Guidance/Standards** ACCA 5 QI-2010. ACCA 9 QIVP-2008. ASHRAE Handbooks: ASHRAE Handbook Series. ASHRAE 52.2-2007. EPA Indoor airPLUS Specifications: 4.1, 4.2 and 4.7.
VENTED COMBUSTION APPLIANCES			
	Complete a safety inspection of all vented combustion appliances in the dwelling (e.g., furnaces, boilers, space heaters, water heaters). The inspection shall include observations for proper clearances, condition of venting, assessment of the potential for backdrafting, integrity of fuel lines, safety of electrical connections and the appliance itself. • For gas-fired appliances and equipment, make this assessment using applicable installation standards, including the National Fuel Gas Code, ANSI Z223.1/NFPA 54, the applicable ANSI Z21 gas-fired appliance safety standard and manufacturer's instructions. Determine whether gas-fired appliance installations comply with Section 9.3 "Air for Combustion and Ventilation" of ANSI Z223.1/NFPA 54 for proper venting, including influences of other building ventilation and exhausting equipment.	Complete all applicable actions under the Assessment Protocols AND ensure compliance with applicable codes and standards. Test combustion appliances for proper draft and venting under worst case conditions before and after retrofit measures that affect envelope leakage and airflows (e.g., air sealing, insulation, addition or upgrade of exhaust fans). Repair, remove or replace combustion equipment and address other issues or deficiencies as needed to meet the applicable codes and standards. ***Note:*** *All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.* Address depressurization and potential backdrafting problems (e.g., with combustion make-up air, fan interlocks, transfer grilles, jumper ducts, louvered doors or door undercuts) OR disable the exhaust equipment causing the problems. If a whole-house fan is used for cooling at night, advise occupants to open several windows before operating the fan.	If replacing combustion equipment located in occupied or conditioned spaces as part of the retrofit process, recommend power vented or sealed combustion equipment (see Section 5.1 of EPA's Indoor airPLUS Construction Specifications). Install new combustion equipment in accordance with ANSI/ACCA 5 QI 2010 HVAC Quality Installation Specifications. **Relevant Guidance/Standards** ACCA 5 QI-2010. EPA Indoor airPLUS Specification 5.1.

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- For oil-fired appliances and equipment, make this assessment using applicable installation standards, including the Standard for the Installation of Oil-Burning Equipment, ANSI/NFPA 31, the applicable ANSI/UL oil-fired appliance safety standard and manufacturer's instructions.

Performance test vented combustion appliances (e.g., boilers, furnaces, space heaters and water heaters) to ensure proper draft under worst case depressurization and perform CO testing.

Conduct Combustion Appliance Zone (CAZ) Worst Case Depressurization testing in accordance with BPI-1100-T-2010, Section 7.5, to determine whether there are any combustion safety issues that may result from changes to the building envelope.

Note
When conducting CAZ testing, a 5 Pa depressurization limit may not be appropriate for all venting conditions. See the BPI CAZ Depressurization Limits table referenced below.

Relevant Guidance/Standards
ANSI Z223.1/NFPA 54.

ANSI Z21 Series Standards for Residential Gas-Fired Appliances.

BPI-1100-T-2010, Combustion Appliance Testing section.

BPI Technical Standards: Technical Standards for the Building Analyst Professional, CAZ Depressurization Limits Table.

Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6).

NFPA 31.

NFPA 211.

Relevant Guidance/Standards
ANSI Z223.1/NFPA 54.

ANSI Z21 Series Standards for Residential Gas-Fired Appliances.

ASHRAE 62.2-2010 Section 6.4.

BPI-1100-T-2010, Combustion Appliance Testing section.

BPI Technical Standards: Technical Standards for the Building Analyst Professional, CAZ Depressurization Limits Table.

Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6).

NFPA 31.

NFPA 211.

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
UNVENTED COMBUSTION APPLIANCES	Identify any unvented gas or kerosene space heaters or vent-free combustion appliances (e.g., fireplaces, cooktops, ovens, kerosene or gas space heaters). Determine whether any state or local regulations prohibiting these devices apply. **Relevant Guidance/Standards** Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). State or local regulations.	Verify that the kitchen exhaust fan vents to the outdoors. If not, see Source Ventilation (page 21) for recommended actions. Identify illegal unvented gas or kerosene space heaters that do not conform to state and local regulations and, with the occupant's permission, remove them as appropriate. If the space heaters are the primary source of heat, replace them with electric or vented, code-compliant heating systems. ***Note:*** *All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.* With the occupant's permission, remove other unvented heaters, except when used as a secondary heat source AND when it can be confirmed that the unit is being used in conformance with ANSI Z21.11.2. Units that are not being operated in compliance with ANSI Z21.11.2 should be removed prior to the retrofit, but may remain until a replacement heating system is in place. If the occupant objects to these recommendations: • Provide the occupant with information about the hazards of operating illegal unvented space heaters or operating vent-free appliances contrary to manufacturers' instructions. For example, the manufacturers' instructions may call for open windows because use of the device requires adequate or additional ventilation to remove products of combustion such as CO, nitrogen oxides, CO_2, PM and water vapor. • For gas-fired unvented space heaters without an oxygen depletion sensor (ODS) shutoff system, suggest the occupant replace with a vented appliance or, at a minimum, consider upgrading the heater to a new model consistent with ANSI Z21.11.2/CSA. • For gas-fired unvented space heaters and vent-free fireplaces that are oversized for the application, advise the occupant of the improper sizing of the appliance.	This cell is intentionally blank.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
UNVENTED COMBUSTION APPLIANCES *(continued)*			
		• Advise the occupant that it is always important to consult and follow the manufacturer's instructions for proper operation and maintenance. If the manufacturer's instructions are not available to the occupant, advise or assist the occupant in obtaining replacement instructions or contacting the Air-Conditioning, Heating and Refrigeration Institute (AHRI) for information on obtaining these instructions for gas appliances. **Relevant Guidance/Standards** AHRI. ANSI Z21.11.2/CSA. Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). Source Ventilation (page 21).	
SOURCE VENTILATION			
	Determine whether the home complies with the local exhaust requirements for kitchens and baths of ASHRAE Standard 62.2-2010, Section 5 and Appendix A, as applicable. Determine whether kitchen and bath exhausts are present and vent to the outdoors. Determine whether the home complies with the local exhaust requirements for clothes dryers in ASHRAE Standard 62.2-2010, Section 6. Determine whether clothes dryers vent to the outdoors. (Condensing dryers are exempt.) Inspect or verify that clothes dryer exhaust duct(s) do not discharge into crawlspaces or attics or within walls. Inspect clothes dryer vents for restrictions and lint buildup. **Relevant Guidance/Standards** ASHRAE 62.2-2010. BPI-1100-T-2010, Indoor Air Quality and Ventilation and Baseload Energy Efficiency sections.	If ASHRAE Standard 62.2-2010 requirements for bathroom, kitchen and clothes dryer exhaust requirements are not met, repair, replace or install local exhaust ventilation to meet the requirements, ensuring ducts are sized, installed and vented properly to the outdoors, OR increase whole-house ventilation airflow to compensate for deficiencies of local exhaust in bathrooms and kitchens using the alternative compliance method (Appendix A of Standard 62.2-2010). • In multi-family buildings, common spaces should be served by dedicated ventilation systems. • Ensure that all clothes dryers exhaust to the outdoors and cannot be readily diverted indoors. (Condensing dryers are exempt.) **Relevant Guidance/Standards** ASHRAE 62.2-2010. BPI-1100-T-2010, Indoor Air Quality and Ventilation section.	If the home is in compliance with ASHRAE Standard 62.2-2010 without bathroom or kitchen exhaust fans (i.e., using Appendix A), EPA recommends installation of exhaust fans vented to the outdoors, in accordance with Section 5 of ASHRAE Standard 62.2-2010 requirements, to improve pollutant source removal. For spaces with strong, localized pollutant sources, consider installing additional (dedicated) local exhaust ventilation. **Relevant Guidance/Standards** ASHRAE 62.2-2010.

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
WHOLE-HOUSE VENTILATION FOR DISTRIBUTED CONTAMINANT SOURCES			
	Determine whether the home complies with the ventilation requirements of ASHRAE Standard 62.2-2010: • Use Section 4 requirements OR use Appendix A – Existing Buildings if local exhaust ventilation in bathrooms and kitchens is deficient. Blower door testing and measuring fan flows (e.g., bathroom or kitchen exhaust) will be required. • Determine whether additional ventilation measures are needed to meet the ASHRAE Standard 62.2-2010 requirements. **Relevant Guidance/Standards** ASHRAE 62.2-2010.	Install additional ventilation measures as necessary to meet ASHRAE Standard 62.2-2010 requirements for whole-building ventilation. If the local exhaust ventilation in bathrooms and kitchens is deficient, use the alternative compliance supplement (Appendix A of Standard 62.2-2010). **Relevant Guidance/Standards** ASHRAE 62.2-2010.	Install a balanced, whole-house ventilation system (e.g., heat recovery ventilator [HRV]). **Relevant Guidance/Standards** NAHB Research Center, http://www.toolbase.org. Search "whole-house ventilation" and "HRV" for additional resources.
MULTI-FAMILY VENTILATION			
	Determine ventilation system type (e.g., fan-powered exhaust, fan-powered outdoor supply or a combination of the two) and whether each system serves individual units, each floor or the entire building. Determine whether existing ventilation meets ASHRAE Standard 62.2-2010 requirements using Appendix A – Existing Buildings for each unit. Determine whether all doors between dwelling units and common hallways are gasketed and airtight with weather stripping (except when the ventilation system design requires air transfer from corridors to units). See ASHRAE Standard 62.2-2010 for additional requirements for each dwelling unit. Determine whether ventilation for common corridors meets ASHRAE 62.1-2010 Table 6-1 (0.06 cfm/ft^2 floor area). **Relevant Guidance/Standards** ASHRAE 62.2-2010. ASHRAE 62.1-2010.	If each dwelling unit is served by its own ventilation equipment, follow Minimum Actions for Whole-House Ventilation for Distributed Contaminant Sources (page 22) and Source Ventilation (page 21). Be certain to include the sealing measures between dwelling units required in Section 6.1 of ASHRAE Standard 62.2-2010. If multiple dwelling units are served by a single exhaust fan, fan-powered outdoor air, or combination of the two, meet 62.2-2010 requirements, paying special attention to sealing measures in Section 6.1 plus: • Seal all the holes that can be sealed in the ventilation ductwork. • Specify and install a balancing device at each exhaust or supply point that, in combination with a sufficiently high operating pressure, ensures constant continuous ventilation which meets the target ventilation rate during all seasons. • Adjust or replace fans so that outlets or inlets have at least 0.2 inches water column (w.c.) pressure difference across the balancing devices in each dwelling unit. • Ensure that ventilation systems run continuously or have dampers installed that prevent airflow between dwelling units when the system is off.	If each dwelling unit is served by its own ventilation equipment, follow the Expanded Actions for Whole-House Ventilation for Distributed Contaminant Sources (page 22) and Source Ventilation (page 21). If multiple dwelling units are served by a single exhaust fan, fan-powered outdoor air, or a combination of the two, meet all the Minimum Actions for Multi-Family Ventilation AND conduct extensive air sealing to compartmentalize each dwelling unit OR design and install individual ventilation systems for each unit to meet the requirements of ASHRAE 62.2-2010 as it applies to new construction. **Relevant Guidance/Standards** ASHRAE 62.2.2-2010. MNCEE: Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments. NCHH Fact Sheet: Improving Ventilation in Existing or New Buildings with Central Roof Exhaust. NCHH Fact Sheet: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation Systems.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
MULTI-FAMILY VENTILATION *(continued)*			
		• Use minimum MERV 6 filters on supply ventilation systems. • In buildings where vertical shafts or ducts and passive rooftop ventilators provide non-fan-powered exhaust to multiple dwelling units, add exhaust fans in combination with the above requirements to provide a more effective ventilation system. **Relevant Guidance/Standards** ASHRAE 62.2-2010. MNCEE: Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments. NCHH Fact Sheet: Improving Ventilation in Existing or New Buildings with Central Roof Exhaust. NCHH Fact Sheet: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation Systems. Source Ventilation (page 21). Whole-House Ventilation for Distributed Contaminant Sources (page 22).	Source Ventilation (page 21). Whole-House Ventilation for Distributed Contaminant Sources (page 22).
SAFETY			
HOME SAFETY			
	Determine whether there are working smoke alarms and CO alarms. Identify knob and tube electrical wiring. Identify harmful chemicals in accessible locations. Check whether there is a fire extinguisher in the home. Determine whether the hot water heater temperature setting is within the allowable limits of the local and state codes. Document other home safety hazards that are observed during the energy audit/assessment/ retrofit (e.g., missing handrails, non-intact stairs, insufficient lighting, holes in floors).	Replace non-working smoke and CO alarms. If smoke alarms or CO alarms are not present, install new alarms. If new batteries are used, install 10-year lithium batteries. (It is recommended that CO alarms have a digital display and provide peak level readings.) Correct life-threatening safety risks (i.e., fall hazards) and provide client education on safety concerns. Do not bury unsafe wiring in attic insulation. **Relevant Guidance/Standards** CPSC Document #466. NFPA 720.	Install CO alarms that can detect and store peak CO levels of less than 30 ppm. Have qualified personnel replace knob and tube wiring in accordance with applicable electrical codes. For households with small children or elderly occupants, discuss scald prevention with clients AND adjust hot water heater set-point to 120 degrees Fahrenheit to prevent scalding. In homes with elderly persons, install grab bars, handrails and lighting as appropriate.

(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
HOME SAFETY *(continued)*	**Relevant Guidance/Standards** CDC Fall Prevention Checklist. CDC Home Safety Checklists. HUD Notice: Public Housing Assessment System Physical Condition Scoring Process Interim Scoring, Corrections and Republication.		For households with small children, recommend installation of gates at the tops of stairs. Recommend installation of light switches at the top and bottom of stairs. Recommend installation of safety lighting above stairs. Consider energy-efficient LED lighting. Recommend repair of malfunctioning doors, windows, roofs and floors. Recommend appropriate and controlled storage of hazardous chemicals (e.g., strong cleaners, household hazardous materials) and pesticides (e.g., remove from accessible locations). Repair identified safety hazards. **Relevant Guidance/Standards** ANSI/UL 2034. EPA Design for the Environment.
JOBSITE SAFETY	Evaluate existing and potential health concerns and activities. Refer to Appendix A: Worker Protection for recommended evaluation measures and actions. ***Note*** *By law, employers and supervisors are required to ensure that workers are working with an OSHA written Safety and Health Plan. More details about these requirements and resources are available in Appendix A: Worker Protection.*	Protect workers and occupants from on-site health and safety hazards by: • Ensuring proper isolation (e.g., sealed with plastic sheeting) and ventilation of work area to the outdoors during activities that result in VOC emissions (e.g., installing spray foam insulation, painting, sealing, finishing) AND ventilating as close to the source of VOCs as possible. • Using appropriate dust control and protective equipment. • Thoroughly cleaning work area before re-occupancy. • Adding precautions to protect occupants during and after installation of spray polyurethane foam: • Evacuating building occupants and other unprotected trade workers from the work area.	For additional information on each of the topics, visit the resources provided under each issue in Appendix A: Worker Protection.

(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
JOBSITE SAFETY *(continued)*		• Using appropriate personal protective equipment (e.g., chemical-resistant [nitrile] gloves, appropriate respirator, chemical-resistant clothing) for anyone in work area. • Cleaning the area thoroughly and waiting until the foam cures before allowing unprotected workers or occupants to reoccupy the work area. See Appendix A: Worker Protection for recommended actions to protect worker safety, including available resources. 	

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NCHH IPM: Integrated Pest Management in Affordable Housing, 2010. National Center for Healthy Housing.
http://www.healthyhomestraining.org/ipm

NIST/NVLAP: Accredited Laboratories for the Polarized Light Microscopy (PLM) Test Method. National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program.
http://ts.nist.gov/Standards/scopes/plmtm.htm

NIST/NVLAP: Accredited Laboratories for the Transmission Electron Microscopy (TEM) Test Method. 2011. National Institute of Standards and Technology/National Voluntary Laboratory Accreditation Program.
http://ts.nist.gov/Standards/scopes/temtm.htm

New York City Department of Health and Mental Hygiene: How to Control Pests Safely. 2008. New York City Department of Health and Mental Hygiene.
http://www.healthyhomestraining.org/IPM/IPM_MFH_Ref_4_NYC_Pest_Control_9-11-08.pdf

Additional Resources

CDC, NIOSH: U.S. Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health.
http://www.cdc.gov/niosh

DOL, OSHA: U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/

EPA IAQ: An Introduction to Indoor Air Quality, Formaldehyde. 2011. U.S. Environmental Protection Agency.
http://www.epa.gov/iaq/formalde.html

EPA IAQ: Care for Your Air: A Guide to Indoor Air Quality. 2008. U.S. Environmental Protection Agency.
http://www.epa.gov/iaq/pdfs/careforyourair.pdf

White House, Recovery Through Retrofit: Recovery Through Retrofit by Middle Class Task Force and Council on Environmental Quality. 2009. White House.
http://www.whitehouse.gov/assets/documents/Recovery_Through_Retrofit_Final_Report.pdf

APPENDIX A

WORKER PROTECTION

Engaging in energy-focused retrofits, home weatherization projects, renovation or remodeling efforts can present risks to occupants, and workers' health and safety may also be compromised if risks are not appropriately assessed and corrective actions are not taken. This appendix was developed to call attention to issues that are of concern to workers' health and safety. Information on assessing the risks to workers, recommended actions to minimize risks to workers' health and safety, and additional resources are provided below.

By law, employers and supervisors are required to ensure that:

1) Work site operations are conducted in compliance with OSHA regulatory requirements.

2) Workers are trained in the hazards of their job and the methods to protect themselves.

3) Workers are provided the protective equipment needed to reduce site exposures.

OSHA regulatory requirements identify the following construction hazards to be addressed:

Chemical Hazards	29 CFR 1926.59
Confined Space	29 CFR 1926.21 (b)(6)(i)
Electrical	29 CFR 1926 Subpart K
Falls	29 CFR 1926.501
Ladders	29 CFR 1926.1053

- Site plans should address safety and health and should include precautions to address multiple construction issues, including the issues outlined below in Table 2. Measures an employer needs to take to evaluate existing and potential health concerns, as well as recommended actions to ensure worker safety, are also included in Table 2. Free help with developing these plans is often available from state or federal training (consulting) programs.
- When known pollutants are being produced or disturbed during retrofit activities, follow appropriate standards (including OSHA, NIOSH, EPA lead safe, and BPI) to minimize worker and occupant exposure.
- When possible, choose construction products whose manufacturers disclose all ingredients and verify that they are free of formaldehyde, mercury and other known toxic substances.

Table 2: Recommended Assessments and Actions for Priority Worker Safety Concerns

Asbestos

Assessment: Determine whether workers will be exposed to asbestos-containing material (ACM).

Actions:

- Retrofitting/renovation activities may expose workers to ACM (e.g., if the home was built before 1990) and require compliance with the OSHA rule at 29 CFR 1926.1101, which provides the required protection measures.
- See OSHA's website on asbestos for additional information and resources.

Chemical Hazards

Assessment: Determine whether workers will be exposed to chemical hazards.

Actions:

- If renovation or retrofitting activities will require the handling of chemical substances, compliance with the OSHA rule at 29 CFR 1926.59 is necessary. It requires that chemical safety information be made available for all chemicals in use, that containers be properly labeled and that workers handling them be properly trained.
- See OSHA's website on chemical hazards communication for additional information and resources.

Confined Space

Assessment: Determine whether workers will be exposed to confined-space hazards.

Actions:

- Ensure work space has breathable air (i.e., ventilate the work space if necessary). Section 5(a)(1) of OSH ACT requires employers to protect workers from serious workplace hazards. Under the OSHA rule at 29 CFR 1926.21 (b)(6)(i), all employees required to enter confined or enclosed spaces must be instructed as to the nature of the hazards involved, the necessary precautions to be taken and the use of required protective and emergency equipment.
- See OSHA's website on confined spaces and OSHA's Confined Spaces E-Tool for additional resources on confined space hazards in general industry.
- See OSHA's Protecting Yourself from Carbon Monoxide Poisoning Quick Card for additional information on sources of CO and recommended actions for preventing CO exposure.
- See EPA's website on the Design for the Environment Program for more information on selecting less toxic products and materials for use in confined spaces.

Dust

Assessment: Determine if the work will create dust.

Actions:

- Workers should know about dust containment procedures and be able to control dust and debris created by equipment used in construction activities.
- Use work methods to minimize dust and prevent dust from spreading to other areas of the home.
- The rooms or areas where work is being done may need to be isolated (e.g., sealed with plastic sheeting) to contain any dust that is generated.
- Turn off forced-air, central heating and air-conditioning systems (including local, window air conditioning units) while work that creates dust is being completed.
- Collect and remove all construction debris.
- Conduct a careful cleanup.
- See OSHA's websites on wood dust, combustible dust, and permissible exposure limits (PELs) for additional information and resources.
- See EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR Part 745) for recommended actions to prevent, contain and clean up dust.

Electrical

Assessment: Determine whether workers will be exposed to electrical hazards.

Actions:

- The OSHA rule at 29 CFR 1926 Subpart K contains requirements for protecting workers from electrical hazards. Employers must make sure that all non-double-insulated electric equipment is equipped with a grounding conductor (three-wire type). Worn or frayed electric cords must not be used. Employers must provide either ground-fault circuit interrupters or an assured equipment grounding conductor program (which includes the regular testing of all equipment grounding conductors) to protect employees from ground faults.
- See OSHA's Electrical Incidents E-Tool for additional information on electrical safety.

Falls

Assessment: Determine whether workers will be required to work at heights of six feet or more.

Actions:

- If work is required at heights of six feet or more, then the workers must be protected with guard rails or tied off to prevent falling. (See OSHA rule at 29 CFR 1926.501 for additional information on requirements.)
- See OSHA's website on fall protection and OSHA's Falls E-Tool for additional information on protecting workers from fall hazards.

Ladders

Assessment: Determine whether workers will be using ladders.

Actions:

- If ladders are used, portable ladders must be able to support at least four times the maximum intended load. Ladders that must lean against a wall are to be positioned at a 4:1 angle. Ladders are to be kept free of oil, grease, wet paint and other slipping hazards. The area around the top and bottom of the ladder must be kept clear. Ladders must not be tied or fastened together to provide longer sections. Metal ladders must not be used while working on electrical equipment and electrical wiring. See the OSHA rule at 29 CFR 1926.1053 for additional information on requirements.
- See OSHA's publication, Stairways and Ladders: A Guide to OSHA Rules, for additional resources on ladder safety.

Lead

Assessment: Determine whether retrofitting or renovation activities will expose workers to lead dust (paint) (e.g., pre-1978 buildings) according to the Assessment Protocols outlined in the Lead section (page 9).

Actions:

- If the facility was built before 1978, the existing paint is assumed to contain lead and retrofitting or renovation activities must comply with EPA's Renovation, Repair and Painting (RRP) Program Rule (40 CFR 745) and the OSHA rule at 29 CFR 1926.62.
- See OSHA's publication Lead in Construction for information on OSHA requirements to protect workers from lead hazards in the construction industry.

Mold

Assessment: Determine whether workers will be exposed to mold.

Actions:

- All suspected moldy areas should be remediated by properly trained individuals. Moisture problems need to be identified and fixed or mold will return. If mold is expected to be disturbed during activities, refer to OSHA's A Brief Guide to Mold in the Workplace, NIOSH's Interim Recommendations for Cleaning and Remediation of Flood-Contaminated HVAC Systems: A Guide for Building Owners and Managers, EPA's Mold Remediation in Schools and Commercial Buildings, ACGIH's Bioaerosols Assessment and Control, AIHA's Recognition, Evaluation, and Control of Indoor Mold or IICRC's S500 Standard and Reference Guide for Professional Water Damage Restoration.
- See EPA's website on mold and moisture for additional information on mold and mold remediation.

Polychlorinated Biphenyls (PCBs)

Assessment: Determine whether workers may be handling PCB-containing or PCB-contaminated building materials, including fluorescent light ballasts and caulk.

Actions:

- See EPA's website on PCB-Containing Light Ballasts for information on proper maintenance, removal and disposal of PCB-containing fluorescent light ballasts. If leaking ballasts are discovered, wear protective clothing including chemical-resistant (nitrile) gloves, boots and disposable overalls.
- See EPA's website on PCBs in Caulk – Steps to Safe Renovation and Repair Activities for additional information on the safe renovation and abatement of buildings that have PCB-containing caulk. Work practices to help ensure worker and occupant safety include employing protective measures (both interior and exterior), complying with occupational protective regulations, communicating with building occupants/third parties, setting up the work area to prevent the spread of dust, using appropriate tools that minimize the generation of dust/heat, and leaving the work area clean. See OSHA rule at 29 CFR 1926.28(a) for information on suitable personal protective equipment (PPE) for dust-generating work methods.

Spray Polyurethane Foam (SPF)

Assessment: Determine whether workers will be using SPF, which may contain chemicals such as isocyanates (e.g., methylene diphenyl diisocyanate [MDI]), amines, flame retardants and other additives. There are three main types of SPF products (two-component high pressure, two-component low pressure, and one-component foam), each of which has different applications. Determine which of the three main types of SPF products will be used.

Actions:

- Applicators, helpers and building occupants in the work area are required to use protective equipment to prevent exposure to isocyanates and other SPF chemicals. Protective equipment requirements vary depending on SPF product.
- Review label and product information for ingredients, hazards, directions, safe work practices and precautions.
- Ensure health and safety training is completed and safe work practices are followed to prevent eye, skin and inhalation exposures during and after SPF installation.
- Exercise caution when determining a safe re-entry time for unprotected occupants and workers based on the manufacturer's recommendation. If you experience breathing problems or other adverse health effects from weatherizing with SPF, seek immediate medical attention.
- See OSHA's Green Job Hazards website for additional information on the hazards associated with SPF.
- See EPA's website on SPF for additional information.
- See American Chemistry Council's Spray Polyurethane Foam Health and Safety website for additional information.

Worker Protection Resources

General

CDC, NIOSH, U.S. Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health.
http://www.cdc.gov/niosh

CDC, NIOSH, Protective Clothing and Ensembles, Safety and Health Topics. 2010. U.S. Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health.
http://www.cdc.gov/niosh/topics/protclothing

CDC, NIOSH, Respirators, Safety and Health Topics. 2011. U.S. Centers for Disease Control and Prevention, The National Institute for Occupational Safety and Health.
http://www.cdc.gov/niosh/topics/respirators

DOL, OSHA, U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov

Asbestos

DOL, OSHA, Asbestos: Asbestos. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/SLTC/asbestos/

DOL, OSHA, 29 CFR Part 1926.1101, subpart Z: Asbestos. Safety and Health Regulations for Construction: Toxic and Hazardous Substances; Sampling and Analysis: Non-mandatory. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10862&p_table=STANDARDS

Chemical Hazards

DOL, OSHA, 29 CFR Part 1926.59, subpart D: Hazard Communication. Safety and Health Regulations for Construction: Occupational Health and Environmental Controls: Hazard Communication. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10633&p_table=STANDARDS

DOL, OSHA, Hazard Communication: Hazard Communication. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/dsg/hazcom/index.html

Confined Space

DOL, OSHA, 29 CFR Part 1926.21 (b)(6)(i), subpart C: Safety and Health Regulations for Construction: General Safety and Health Provisions: Safety Training and Education. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10607&p_table=STANDARDS

DOL, OSHA, Carbon Monoxide Poisoning Quick Card: Protecting Yourself from Carbon Monoxide Poisoning Quick Card. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/Publications/3282-10N-05-English-07-18-2007.html

DOL, OSHA, Confined Spaces E-Tool: Confined Spaces E-Tool. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/dts/osta/oshasoft/index.html

DOL, OSHA, Confined Spaces: Confined Spaces. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/SLTC/confinedspaces/index.html

DOL, OSHA, OSH ACT: Section 5 (a)(1). U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=OSHACT&p_id=3359

EPA Design for the Environment: Safer Product Labeling Program. 2011. U.S. Environmental Protection Agency.
http://epa.gov/dfe/pubs/projects/formulat/formpart.htm

Dust

DOL, OSHA, Combustible Dust: Combustible Dust. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/dsg/combustibledust/index.html

DOL, OSHA, Permissible Exposure Limits (PELs): Permissible Exposure Limits (PELs). U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/SLTC/pel/

DOL, OSHA, Wood Dust: Wood Dust. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/SLTC/wooddust/index.html

EPA Renovation, Repair and Painting (RRP) Program Rule: 40 CFR Part 745: Lead; Clearance and Clearance Testing Requirements for the Renovation, Repair and Painting Program, Proposed Rule, FR Vol. 75, No. 87, pages 25038-25073. 2010. U.S. Environmental Protection Agency.
http://edocket.access.gpo.gov/2010/pdf/2010-10102.pdf
http://www.epa.gov/lead/pubs/renovation.htm

Electrical

DOL, OSHA, 29 CFR Part 1926, subpart K: Electrical Standards for Construction. U.S. Department of Labor, Occupational Safety and Health Administration
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=16956

DOL, OSHA, Electrical Incidents E-Tool: U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/SLTC/etools/construction/electrical_incidents/mainpage.html

Falls

DOL, OSHA, 29 CFR Part 1926.501, subpart M: Fall Protection. Safety and Health Regulations for Construction. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10757&p_table=STANDARDS

DOL, OSHA, Falls: Falls. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/SLTC/fallprotection/index.html

DOL, OSHA, Falls E-Tool: Falls E-Tool. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/SLTC/etools/construction/falls/mainpage.html

Ladders

DOL, OSHA, 29 CFR Part 1926.1053, subpart X: Ladders. Safety and Health Regulations for Construction. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10839

DOL, OSHA, Stairways and Ladders: Stairways and Ladders: A Guide to OSHA Rules. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/Publications/osha3124.pdf

Lead

DOL, OSHA, 29 CFR Part 1926.62, subpart D: Lead. Safety and Health Regulations for Construction: Occupational Health and Environmental Controls. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10641

DOL, OSHA, Lead - Construction: Lead - Construction. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/SLTC/lead/construction.html

EPA Renovation, Repair and Painting (RRP) Program Rule: 40 CFR Part 745: Lead; Clearance and Clearance Testing Requirements for the Renovation, Repair and Painting Program, Proposed Rule, FR Vol. 75, No. 87, pages 25038-25073. 2010. U.S. Environmental Protection Agency.
http://edocket.access.gpo.gov/2010/pdf/2010-10102.pdf
http://www.epa.gov/lead/pubs/renovation.htm

Mold

ACGIH: Bioaerosols Assessment and Control. 1999. American Conference of Governmental Industrial Hygienists.
http://www.acgih.org/store/productdetail.cfm?id=349

AIHA: Recognition, Evaluation, and Control of Indoor Mold. 2008. American Industrial Hygiene Association.
https://webportal.aiha.org/Purchase/ProductDetail.aspx?Product_code=3f9e0a5a-4778-de11-96b0-0050568361fd

CDC Mold Cleanup: Mold Cleanup. 2010. U.S. Centers for Disease Control and Prevention.
http://www.cdc.gov/mold/cleanup.htm

CDC Mold Prevention Strategies: Mold Prevention Strategies and Possible Health Effects in the Aftermath of Hurricanes and Major Floods. 2006. U.S. Centers for Disease Control and Prevention.
http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5508a1.htm

CDC, NIOSH, Cleaning and Remediation of HVAC Systems: NIOSH Interim Recommendations for the Cleaning and Remediation of Flood Contaminated HVAC Systems: A Guide for Building Owners and Managers. U.S. Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health.
http://www.cdc.gov/niosh/nas/rdrp/appendices/chapter10/a10-14.pdf

DOL, OSHA, Mold in Workplace: A Brief Guide to Mold in the Workplace. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/dts/shib/shib101003.html

EPA Mold: Mold Remediation in Schools and Commercial Buildings. 2010. U.S. Environmental Protection Agency.
http://www.epa.gov/iedmold1/mold_remediation.html

EPA Mold: Mold and Moisture. 2010. U.S. Environmental Protection Agency.
http://www.epa.gov/mold/

IICRC: S500 Standard and Reference Guide for Professional Water Damage Restoration. 2006. Institute of Inspection, Cleaning and Restoration Certification.
http://www.iicrc.org/pdf/buydocs.pdf

Polychlorinated Biphenyls (PCBs)

EPA PCB-Containing Light Ballasts: Proper Maintenance, Removal, and Disposal of PCB-Containing Fluorescent Light Ballasts. 2011. U.S. Environmental Protection Agency.
http://www.epa.gov/epawaste/hazard/tsd/pcbs/pubs/ballasts.htm

EPA PCBs in Caulk – Steps to Safe Renovation and Repair Activities: 2011. U.S. Environmental Protection Agency.
http://www.epa.gov/pcbsincaulk/guide/guide-sect2.htm

DOL OSHA, 29 CFR Part 1926.28(a), subpart C: Personal Protective Equipment. Safety and Health Regulations for Construction: Occupational Health and Environmental Controls. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10614

Spray Polyurethane Foam

American Chemistry Council: Spray Polyurethane Foam Health and Safety. American Chemistry Council.
http://www.spraypolyurethane.org

DOL, OSHA, Green Jobs Hazards: Green Jobs Hazards, Weather Insulating/Sealing. U.S. Department of Labor, Occupational Safety and Health Administration.
http://www.osha.gov/dep/greenjobs/weather_spf.html

EPA SPF: Spray Polyurethane Foam. 2011. U.S. Environmental Protection Agency.
http://www.epa.gov/dfe/pubs/projects/spf/spray_polyurethane_foam.html

EPA SPF: Spray Polyurethane Foam, Building Occupants and Other Workers Should Vacate During SPF Installation. 2011. U.S. Environmental Protection Agency.
http://www.epa.gov/dfe/pubs/projects/spf/spray_polyurethane_foam.html#building

APPENDIX B

CLIENT EDUCATION

Why Provide Client Education

Home energy upgrades, when completed in accordance with **EPA's Healthy Indoor Environment Protocols for Home Energy Upgrades,** can help improve the indoor air quality and safety in homes. Energy upgrade work also presents a valuable chance to interact with occupants, giving the contractor an opportunity to provide helpful education on indoor air quality and safety to further ensure the positive impact of a more energy efficient, healthier home. With effective education, occupants are better prepared to maintain healthy home improvements and less likely to create new health hazards in their homes.

Key Issues

Programs, crews and contractors are encouraged to incorporate into their client education strategies a set of messages related to 12 topics identified in the protocols for occupant education (presented here alphabetically):

1. Asbestos.
2. Asthma triggers.
3. Carbon monoxide (CO) and other combustion pollutants.
4. Environmental tobacco smoke (ETS).
5. Lead.
6. Mold and moisture.
7. Pests.
8. Polychlorinated biphenyls (PCBs).
9. Radon.
10. Safety.
11. Volatile organic compounds (VOCs) in household products and materials.
12. Wood smoke and solid fuel emissions.

These issues and health messages are described in Table 3, which summarizes how these priority indoor environmental concerns affect occupants and provides suggested occupant education health messages. Occupant health messages can be used to communicate key points regarding these 12 important topics for healthy indoor environments.

EPA has many publications suitable for occupant education on indoor air quality in homes, including **Care for Your Air: A Guide to Indoor Air Quality**, which can be found on EPA's Indoor Air Quality home page, www.epa.gov/iaq.

Table 3: Priority Health Concerns and Recommended Occupant Health Messages

Priority Health Concerns	Recommended Occupant Health Messages
Asbestos – Asbestos-containing materials (ACM) in homes may include pipe and furnace insulation, vermiculite insulation installed before 1990, floor tiles, exterior shingles and roofing. Exposure can cause lung cancer, mesothelioma (cancer of the lining of the chest and abdominal cavity) and asbestosis, in which the lungs become scarred with fibrous tissue.	• Do not disturb materials that may contain asbestos including pipe insulation, attic vermiculite insulation, exterior shingles and floor tiles (particularly 9-inch by 9-inch tiles). • Consult state requirements for asbestos testing and mitigation.
Asthma Triggers – Asthma triggers are commonly found in homes, schools and offices and include moisture, mold, dust mites, pests such as cockroaches or mice, secondhand smoke and pet dander. A home may have mold growing on a shower curtain, dust mites in pillows, blankets or stuffed animals, secondhand smoke in the air and cat and dog hairs on the carpet or floors. Asthma triggers cause symptoms including coughing, chest tightness, wheezing and breathing problems. An asthma attack occurs when symptoms keep getting worse or are suddenly very severe. Asthma attacks can be life threatening.	• Asthma can be controlled with the right medicines and by reducing asthma triggers. • For dust mites, wash bedding in hot water once a week and dry completely. Use dust-proof (allergen-impermeable) mattress and pillow covers. Choose washable stuffed toys; wash them often in hot water, and dry thoroughly. • Keep pets out of bedrooms and off furniture. Consider keeping pets outside, if possible. • See sections of this table on Environmental Tobacco Smoke, Mold and Moisture, and Pests for recommendations regarding these asthma triggers.
Carbon Monoxide (CO) and Other Combustion Pollutants – Combustion pollutants are gases or particles that come from burning materials. Common combustion pollutants include carbon monoxide (CO) and nitrogen dioxide (NO_2). Exposure to CO can cause headaches, impaired vision and coordination, flu symptoms, dizziness, and at high concentrations, confusion, nausea and death. CO sources include combustion equipment (e.g., furnaces and wood stoves), unvented combustion appliances (e.g., vent-free fireplaces), portable generators, and other combustion equipment and automobiles operated in attached garages. NO_2 is a colorless, odorless gas that causes eye, nose and throat irritation, shortness of breath and an increased risk of respiratory infection.	• CO alarms should be installed in all homes. • Annually test CO alarms. Replace every five to seven years. It is recommended that CO alarms have a digital display and provide peak level readings. *Note: Some CO alarms can detect and store low level peak CO levels (less than 30 ppm).* • Never operate a portable generator or any gasoline engine-powered tool in or near an enclosed space such as a garage, house or other building. Even with open doors and windows, these spaces can trap CO and allow it to quickly build to lethal levels. • Never warm up cars in attached garages, even if the garage door to the outside is open. • For gas vent-free heaters and fireplaces, inform occupant of identified operation or installation issues and suggested actions. • Consult manufacturer installation and operating instructions for proper operation and maintenance of gas appliances. If manufacturer instructions are not available, contact manufacturer to obtain replacement instructions or contact the Air-Conditioning, Heating and Refrigeration Institute (AHRI) for information on obtaining these instructions for gas appliances.
Environmental Tobacco Smoke (ETS) – Exposure to ETS, also known as "secondhand smoke," can occur if someone smokes in a home or apartment building. Exposure to secondhand smoke increases the risk of lung cancer in adults. Children are at increased risk of ear infections, bronchitis and pneumonia, Sudden Infant Death Syndrome (SIDS) and asthma symptoms. Secondhand smoke triggers symptoms in people who have asthma or chronic obstructive pulmonary disease (COPD).	• Secondhand smoke poses health risks to non-smokers (e.g., cancer in adults, SIDS, breathing problems in children). • Do not allow smoking in the home. Smoke outside to reduce the risk to others in the home. • Provide access to information on local smoking cessation programs for those who want to quit. • Explore smoke-free housing policies for multi-family properties. Explain financial and reduced liability benefits to owners. See the National Center for Healthy Housing's fact sheet Reasons to Explore Smoke Free Housing for additional information.

Priority Health Concerns	Recommended Occupant Health Messages
Lead – Housing-related lead sources include flaking or peeling lead-based paint, leaded dust, lead in soil and lead in drinking water. Exposure can cause learning difficulties, behavior problems, hearing damage and in extreme cases seizures or death. Children under six years of age and pregnant women are at greatest risk.	• Pregnant women and children under six years are at greatest risk. • In homes built before 1978: 1) If repainting, remodeling or disturbing paint, use lead safe-work practices; 2) Repair peeling paint using lead safe work practices in homes where young children or pregnant women live. • Consider testing blood lead levels in children younger than six years of age, if living in a pre-1978 home. • For pre-1978 homes with chipping exterior paint: Test soil for lead content and remove or cover lead-contaminated soil.
Mold and Moisture – Mold can grow almost anywhere there is moisture in a house. Asthma symptoms, allergic reactions, and other respiratory symptoms can be triggered by damp indoor environments and mold. Inhaling mold spores can trigger asthma attacks in people sensitive to molds.	• If you see mold on hard surfaces, clean it up with soap and water. Let the area dry completely. • Repair moisture problems to avoid dampness or mold. • Dry water-damaged areas and items within 24-48 hours after a leak or spill to prevent mold growth. • Avoid installing carpet in areas prone to wetting or moisture problems. • Run bathroom and kitchen fans when showering, cooking, etc., and run whole-house ventilation system according to manufacturer's instructions to help minimize moisture and contaminant buildup.
Pests – Rodents, cockroaches, termites, birds, bats and other pests can be found in homes. Exposure to some pest droppings and body parts (e.g., from mice and cockroaches) can trigger asthma attacks. Rodents can also carry diseases such as hantavirus, which can result in a deadly condition called hantavirus pulmonary syndrome (HPS). Misusing pesticides to address pest problems can sometimes result in harmful exposures to carcinogens or chemicals that result in respiratory problems or allergic reactions.	• Follow integrated pest management (IPM) strategies to reduce pest infestations and to avoid the overuse of pesticides: 1) Reduce pest access to water and food by properly storing food and trash and by using effective housekeeping techniques; 2) Limit pest entry by sealing holes and cracks; 3) Use targeted and least toxic pesticides. • Clean up pest droppings and body parts to reduce allergens. • Safely store pesticides out of reach of children.
Polychlorinated Biphenyls (PCBs) – PCBs were manufactured domestically from 1929 until their manufacture was banned in 1979. PCBs have been shown to cause a variety of adverse health effects, including effects on the immune system, reproductive system, nervous system and endocrine system in animals. PCBs have also been shown to cause cancer in animals. Studies in humans provide supportive evidence for potential carcinogenic and non-carcinogenic effects of PCBs.	• Although no longer commercially produced in the U.S., PCBs may be present in products and materials produced before the 1979 PCB ban (e.g., transformers and capacitors, cable insulation, oil-based paint, caulk, plastics, floor finish). • Materials suspected of PCB contamination should be sampled, tested and safely abated by a professional.
Radon – Radon is the #1 cause of lung cancer for non-smokers. It is the 2nd leading cause of lung cancer overall (after smoking), accounting for 21,000 deaths annually. A radioactive gas that comes from the natural decay of uranium in soil and water, radon can enter homes through openings in walls and floors where they come into contact with the ground. An estimated one in every 15 U.S. homes has radon levels at or above EPA's action level of 4 pCi/L.	• The only way to know the radon level in your home is to test for it. • EPA and the Surgeon General recommend testing all homes below the third floor for radon. • Mitigate radon in homes if levels are greater than or equal to 4 pCi/L. Strongly consider mitigating homes with levels between 2 and 4 pCi/L. ○ Radon levels below 4 pCi/L still pose a health risk and in many cases may be reduced. See EPA's **A Citizen's Guide to Radon**. • Make sure any existing radon mitigation system is functioning properly. If a vent fan is installed, check its condition first.

Priority Health Concerns	Recommended Occupant Health Messages
Safety – Trips and falls, poisoning and burns are significant injury risks in homes. Poor lighting, lack of handrails, unstable stairs and other housing hazards increase the risk of falls. Improperly stored chemicals increase the risk of poisoning.	• Smoke alarms and CO alarms should be installed in all homes and tested regularly. Replace batteries annually. Replace smoke alarms every 10 years and CO alarms every five to seven years. • Set hot water heater thermostats to 120 degrees Fahrenheit to reduce burns and scalds. • In homes where elderly persons live, reduce trip hazards, provide sufficient lighting on stairs, ensure handrails and grab bars are in key locations, and follow CDC's guide Check for Safety: A Home Fall Prevention Checklist for Older Adults. • In homes with young children, install gates at the tops of stairs and securely store chemicals and pesticides.
Volatile Organic Compounds (VOCs) in Household Products and Materials – VOCs are found in many household products and materials including paints, carpets and pads, pressed wood, composite wood, cleaning supplies, air fresheners and furniture. Exposures can cause eye, nose and throat irritation, liver damage and cancer.	• Select low-VOC products when possible (e.g., paint, carpet, furniture, cabinets, adhesives and cleaning products). Green testing and rating programs that assess products for VOCs and other health hazards include: o California Department of Public Health, Emission Testing Method for California Specification 01350. o Carpet and Rug Institute (CRI) Green Label or Green Label Plus program criteria or equivalent standards for carpet. o Collaborative for High Performance Schools (CHPS) High Performance Products Database. o Green Seal Standard GS-11. o Greenguard Children and Schools Certification Program. o Master Painters Institute (MPI) Green Performance Standards GPS-1 or GPS-2. o Scientific Certification Systems (SCS) Standard EC-10.2-2007 (Indoor Advantage Gold). • If using pressed or composite wood products, avoid products containing urea formaldehyde. Select products compliant with California Title 17. • Local ventilation can be used when strong sources of VOCs or other airborne contaminants are isolated to a specific room or area. Whole-house ventilation will also help reduce VOCs and other airborne contaminants in most homes. • Safely store chemicals out of reach of children.
Wood Smoke and Solid Fuel Emissions – Wood stoves and fireplaces can create emissions, and exposures can cause breathing problems.	• Ensure fireplace chimney or wood stove flue is working properly (i.e., there is no wood smoke in the home). • Clean chimney once a year. • Follow EPA's Guide for Best Burn Practices for Wood Stoves. • If purchasing a new stove, ensure it is EPA-certified.

Client Education Resources:

Asbestos

EPA Asbestos: Asbestos in Your Home. 1990. U.S. Environmental Protection Agency.
http://www.epa.gov/asbestos/pubs/ashome.html
http://www.epa.gov/asbestos/

Asthma Triggers

EPA Asthma: Indoor Environmental Asthma Triggers. 2011. U.S. Environmental Protection Agency.
http://www.epa.gov/asthma/triggers.html

Carbon Monoxide

AHRI: Air-Conditioning, Heating and Refrigeration Institute.
http://www.ahrinet.org/default.aspx

CPSC Document #466: Carbon Monoxide Questions and Answers. 2008. U.S. Consumer Product Safety Commission.
http://www.cpsc.gov/cpscpub/pubs/466.html

EPA IAQ: An Introduction to Indoor Air Quality (IAQ), Carbon Monoxide. U.S. Environmental Protection Agency. 2011.
http://www.epa.gov/iaq/co.html

Environmental Tobacco Smoke

EPA Smoke-free Homes and Cars Program: U.S. Environmental Protection Agency. 2010.
http://www.epa.gov/smokefree/

NCHH Fact Sheet: Reasons to Explore Smoke-Free Housing. 2009. National Center for Healthy Housing.
http://www.nchh.org//Portals/0/Contents/Green%20Factsheet_Smokefree.pdf

Lead

EPA Lead-Based Paint Renovation, Repair, and Painting Program: Lead Safe Certified Guide to Renovate Right Brochure. 2010. U.S. Environmental Protection Agency.
http://www.epa.gov/lead/pubs/renovaterightbrochure.pdf

Mold and Moisture

EPA Mold: A Brief Guide to Mold, Moisture, and Your Home. 2010. U.S. Environmental Protection Agency.
http://www.epa.gov/iedmold1/moldguide.html

Pests

EPA Pests: Controlling Pests. U.S. Environmental Protection Agency. 2011.
http://www.epa.gov/pesticides/controlling/index.htm

New York City Department of Health and Mental Hygiene: How to Control Pests Safely. 2008. New York City Department of Health and Mental Hygiene.
http://www.healthyhomestraining.org/IPM/IPM_MFH_Ref_4_NYC_Pest_Control_9-11-08.pdf

Polychlorinated Biphenyls (PCBs)

EPA PCB: Polychlorinated Biphenyls. 2011. U.S. Environmental Protection Agency.
http://www.epa.gov/epawaste/hazard/tsd/pcbs/index.htm

Radon

EPA Radon Guidance: Citizen's Guide to Radon. 2009. U.S. Environmental Protection Agency.
http://www.epa.gov/radon/pubs/citguide.html

Safety

CDC Fall Prevention Checklist: Check for Safety: A Home Fall Prevention Checklist for Older Adults. 2009. U.S. Centers for Disease Control and Prevention.
http://www.cdc.gov/HomeandRecreationalSafety/Falls/CheckListForSafety.html

Volatile Organic Compounds in Household Products and Materials

California Department of Public Health CAL-IAQ Program Standard: Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1. 2010. California Department of Public Health.
http://www.cal-iaq.org/vocs/standard-method-for-voc-emissions-testing-and-evaluation

California Title 17: California Code of Regulations, Title 17, sections 93120 - 93120.12. 2008. State of California.

CRI: Green Label, Green Label Plus. The Carpet and Rug Institute.
http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/green-label-plus/

EPA IAQ: An Introduction to Indoor Air Quality (IAQ), Volatile Organic Compounds (VOCs). 2011. U.S. Environmental Protection Agency.
http://www.epa.gov/iaq/voc.html

Greenguard Children and Schools Certification Program: Greenguard Environmental Institute.
http://www.greenguard.org/en/QuickSearch.aspx

Green Seal Standard GS-11: GS-11: Green Seal Environmental Standard for Paints and Coatings. 2008. Green Seal, Inc.
http://www.greenseal.org/GreenBusiness/Standards.aspx?vid=ViewStandardDetail&cid=0&sid=6

MPI GPS-1 and GPS-2: Master Painters Institute (MPI) Green Performance Standards for Paints and Coatings [GPS-1 and GPS-2]. 2008. Master Painters Institute, Inc.
http://www.specifygreen.com/EvrPerf/EnvironmentalPerformance.html

SCS Standard EC-10.2-2007: Standard EC-10.2-2007, Indoor Air Quality Performance. 2007. Scientific Certification Systems.
http://www.scscertified.com/docs/SCS-EC10.2-2007.pdf

Wood Smoke and Solid Fuel Emissions

CSIA: Top-Down Method of Stove Loading. Chimney Safety Institute of America.
http://www.csia.org/HomeownerResources/ChimneySafetyInfo/HOWTOBuildaTopDownBurn/tabid/229/Default.aspx

EPA Burn Wise Guides: Burn Wise Guide for Best Burn Practices for Wood Stoves. 2011. U.S. Environmental Protection Agency.
http://www.epa.gov/burnwise/bestburn.html

APPENDIX C

ABBREVIATIONS

AC – Air Conditioning

ACCA – Air Conditioning Contractors of America

ACM – Asbestos-Containing Material

AFHH – Alliance for Healthy Homes

AHRI – Air-Conditioning, Heating and Refrigeration Institute

ANSI – American National Standards Institute

ASHI – American Society of Home Inspectors

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASPE – American Society of Plumbing Engineers

ASTM – American Society for Testing and Materials

BPI – Building Performance Institute

CA – California

CAZ – Combustion Appliance Zone

CDC – Centers for Disease Control and Prevention

CEQ – White House Council on Environmental Quality

cfm – Cubic feet per minute

CFR – Code of Federal Regulations

CHPS – Collaborative for High Performance Schools

CO – Carbon Monoxide

CO_2 – Carbon Dioxide

COPD – Chronic Obstructive Pulmonary Disease

CPSC – Consumer Product Safety Commission

CRI – Carpet and Rug Institute

CSA – Canadian Standards Association

CSIA – Chimney Safety Institute of America

DOE – U.S. Department of Energy

DOL – U.S. Department of Labor

EPA – U.S. Environmental Protection Agency

EPA OSWER – U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response

ETS – Environmental Tobacco Smoke

ft^2 – Square feet

GS – Green Seal

HPS – Hantavirus Pulmonary Syndrome

HRV – Heat Recovery Ventilator

HUD – U.S. Department of Housing and Urban Development

HVAC – Heating, Ventilating and Air Conditioning

IAQ – Indoor Air Quality

IPM – Integrated Pest Management

LED – Light-Emitting Diode

MDI – Methylene Diphenyl Diisocyanate

MERV – Minimum Efficiency Reporting Value

MNCEE – Minnesota Center for Energy and Environment

MPI – Master Painters Institute

MPI GPS – Master Painters Institute Green Performance Standard

N/A – Not Applicable

NAHB – National Association of Home Builders

NCHH – National Center for Healthy Housing

NEHA – National Environmental Health Association

NESCAUM – The Clean Air Association of the Northeast States

NFI – National Fireplace Institute

NFPA – National Fire Protection Association

NIOSH – National Institute for Occupational Safety and Health

NIST – National Institute of Standards and Technology

NRSB – National Radon Safety Board

NVLAP – National Voluntary Laboratory Accreditation Program

ODS – Oxygen Depletion Sensor

OSHA – Occupational Safety and Health Administration

PCBs – Polychlorinated Biphenyls

pCi/L – picocuries per liter

PELs – Permissible Exposure Limits

PLM – Polarized Light Microscopy

ppm – Parts per million

RRP – Renovation, Repair and Painting

SCS – Scientific Certification Systems

SIDS – Sudden Infant Death Syndrome

SPF – Spray Polyurethane Foam

TEM – Transmission Electron Microscopy

U.S. – United States

VOCs – Volatile Organic Compounds

W.C. – Water Column

XRF – X-Ray Fluorescence

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Environmental Protection
Agency

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http://www.epa.gov/iaq/homes/retrofits.html