



Healthy Homes: Insights for Existing Housing


www.phrc.psu.edu

PennState
College of Engineering

PENNSYLVANIA HOUSING
RESEARCH CENTER

NARI
CEU Approved

ICC
PREFERRED
EDUCATION
PROVIDER

PHRC


Pennsylvania Housing Research Center


- The Pennsylvania Housing Research Center (PHRC) provides and facilitates education, training, innovation, research, and dissemination to the residential construction industry for the purpose of improving the quality and affordability of housing.
- Educational programs and publications by the PHRC address a wide range of topics relevant to the home building industry and are designed to reach a diverse audience: builders, code officials, remodelers, architects, developers, engineers, planners, landscape architects, local government officials, educators, etc. to provide professional development and continuing education.



Continuing Education

- **At end of the program, you can register for a certificate to receive the following credits for this session:**
 - 1.0 PA Dept L&I Contact Hour
 - 1.0 PDH
 - 1.0 AIA LU|HSW (PHRCWEB4121)
 - 1.0 ICC Contact Hour (0.1 CEU) (25492)
 - 1.0 NARI hour/CEU

NARI
CEU Approved





5



6

Learning Objectives

1. Review connections between occupant health and common conditions in existing housing, such as how mold in chronically damp areas of the home can lead to human illness
2. Explore how moisture reduction strategies such as effective drainage and air sealing can reduce dampness and improve indoor environmental quality
3. Examine how home ventilation system improvements can reduce risk of occupant respiratory illnesses
4. Identify resources for building professionals to identify, evaluate, and remediate unhealthy conditions in the physical design of existing housing

7



Outline

- Goal
- History & Context
- Introduction to 8 Healthy Home Principles
- Healthy Home Upgrades

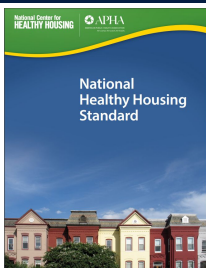


<https://bookstore.gpo.gov/products/2016-healthy-homes-calendar>

8



Goal: Build Awareness



KEEP IT
CLEAN



KEEP IT
DRY



KEEP IT
PEST-FREE



KEEP IT
CONTAMINANT-
FREE



KEEP IT
SAFE



KEEP IT
VENTILATED



KEEP IT
COMFORTABLE



KEEP IT
MAINTAINED

www.bpl.org/healthy-housing-principles

<https://nchh.org/resource-library/national-healthy-housing-standard.pdf>



9

1938: American Public Health Association (APHA) Committee on the Hygiene of Housing

- **30 principles**
- **4 categories:**
 - Fundamental **physiologic** needs
 - Fundamental **psychologic** needs
 - Protection from **disease**
 - Protection from **accidents**

Basic Principles of Healthful Housing:
Preliminary Report of the Committee on
Hygiene of Housing. Am J Public Health
Nations Health. 1938 Mar;28(3):351-72.

Basic Principles of Healthful Housing*

Preliminary Report

COMMITTEE ON THE HYGIENE OF HOUSING
AMERICAN PUBLIC HEALTH ASSOCIATION

C.-E. A. WINSLOW, *Chairman*

FREDERICK J. ADAMS	J. ANDRÉ FOULSHOOK
ERLEO H. BRETTON	GREEN GRAY
F. STUART CHAPIN	JAMES E. IYER
JOEL I. CONSOLEY	MURTON G. LLOYD
ROBERT L. DAVISON	B. M. PETTIT
EARLE S. DRAPER	GEORGE C. RICHLAND
JAMES FORD	H. A. WHITTAKER
ALLAN A. TWICKELL, <i>Technical Secretary</i>	
PHILIP E. NELBACH, <i>Field Secretary</i>	

10

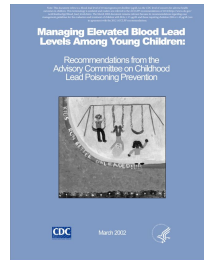
1970s to today

1970s | Programs to:

- Improve outdoor air quality
- Improve **indoor air quality**
- Improve drinking water quality
- Prevent **childhood lead poisoning**

1990s | Programs to prevent:

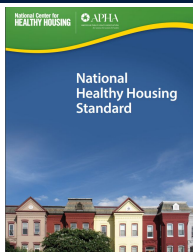
- **Lead poisoning**
- **Asthma**
- **Injury**



11

2014: National Healthy Housing Standard

- **20-30%** of **asthma** cases are linked to housing conditions
- **21,000** annual lung cancer deaths from **radon**
- **24 million** existing homes have **lead-based paint** hazards
- **6 million** preventable falls each year from adults over 65
- **Home injuries** are the leading causes of death for young children



12

<https://hchh.org/resource-library/national-healthy-housing-standard.pdf>

Building Performance Institute (BPI) Healthy Housing Principles

1. Keep it... **Clean**
2. Keep it... **Dry**
3. Keep it... **Pest-Free**
4. Keep it... **Contaminant-Free**
5. Keep it... **Safe**
6. Keep it... **Ventilated**
7. Keep it... **Comfortable**
8. Keep it... **Maintained**



www.bpi.org/healthy-housing-principles



13

Healthy Home Remodeling: JCHS Study



- Published in **January 2019**
- US survey of homeowners, renters, & remodeling contractors
- **30%** of US households expressed concerns about health risks of their home
- Top health concern: **indoor air quality (IAQ)**
- Top IAQ worries:
 - 1) **dampness/mold/moisture**
 - 2) **household dust**

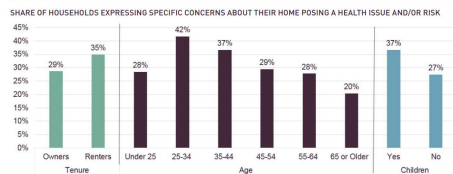
www.jchs.harvard.edu/research-areas/research-briefs/healthy-home-remodeling-consumer-trends-and-contractor-preparedness



14

Healthy Housing: Who is Concerned

FIGURE 2: HEALTHY HOUSING CONCERNS HIGHEST AMONG RENTERS, MILLENNIALS, FAMILIES WITH CHILDREN



Note: Out of a sample of 1,000 homeowners and 700 renters.
Source: Parthenon Group and Joint Center for Housing Studies, August 2016.

www.jchs.harvard.edu/research-areas/research-briefs/healthy-home-remodeling-consumer-trends-and-contractor-preparedness

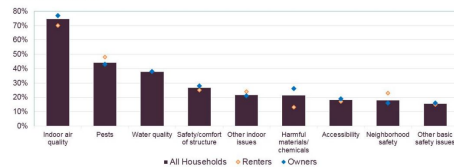


15

Top Health Concern: Indoor Air Quality (IAQ)

FIGURE 4: INDOOR AIR QUALITY, PESTS, AND WATER QUALITY ISSUES TOP LIST OF CONCERNS ABOUT THE IMPACT OF HOME ON HEALTH

WHICH CATEGORY OR CATEGORIES BEST DESCRIBE YOUR CONCERN ABOUT THE IMPACT OF YOUR HOME ON YOUR HOUSEHOLD'S HEALTH?



Note: Out of a sample of 501 homeowners and 202 renters concerned about specific healthy housing issues.

Source: Research Group and Joint Center Healthy Homes Survey, August 2018.

www.jchs.harvard.edu/research-areas/research-briefs/healthy-home-remodeling-consumer-trends-and-contractor-preparedness

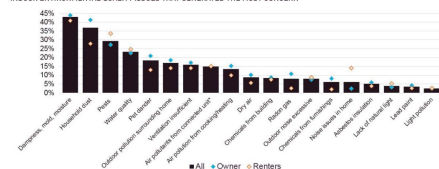


16

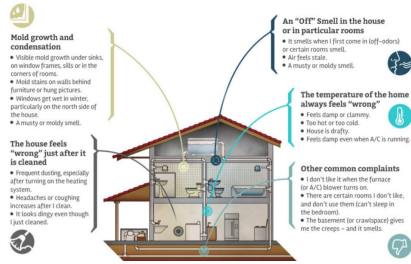
Top IAQ Concern: Dampness/Mold/Moisture

FIGURE 5: DAMPNES/MOLD, HOUSEHOLD DUST, PESTS TOP LIST OF CONCERNS ABOUT INDOOR ENVIRONMENTAL QUALITY ISSUES

INDOOR ENVIRONMENTAL QUALITY ISSUES THAT GENERATED THE MOST CONCERN



Signs & Symptoms

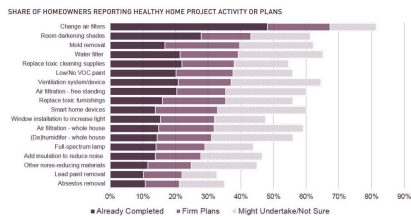


19



Healthy Homes Work: DIY Projects

FIGURE 4: MANY DO-IT-YOURSELF JOBS TOPPED THE LIST OF POPULAR HEALTHY HOME PROJECTS

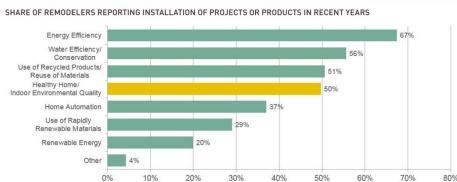


20



Healthy Home Work: Remodelers

FIGURE 8: HALF OF REMODELERS REPORTED INSTALLING HEALTHY HOME PROJECTS IN RECENT YEARS



Notes: Respondents were asked, "Which of the following categories describe remodeling projects and/or products that your company has installed in recent years?" Sample size is 579. Source: Remodeler Group and Joint Center for Remodeling Contractor Healthy Home Survey, August 2018.

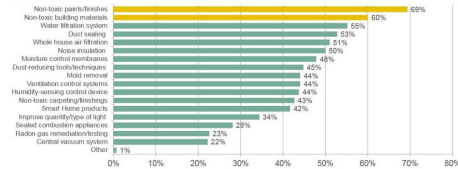
21



Healthy Home Work: Remodelers

FIGURE 10: 'NON-TOXIC' PRODUCTS ARE MOST FREQUENTLY INSTALLED BY CONTRACTORS ENGAGED IN HEALTHY HOME REMODELING

SHARE OF CONTRACTORS ENGAGED IN HEALTHY HOME REMODELING REPORTING INSTALLATION IN RECENT YEARS



Notes: Respondents engaged in healthy home projects were asked, "Which of the following categories describe remodeling projects and/or products that your company has installed in recent years?" Sample size is 288.
Source: Harvard T.H. Chan School of Public Health Center for Healthy Home Remodeling Contractor Healthy Home Survey, August 2018.

www.hs-niederrhein.de/research-areas/research-briefs/healthy-home-remodeling-consumer-trends-and-contractor-preparedness



22

Pennsylvania Housing Quality

Housing Quality



www2.census.gov/programs-surveys/ahs/2017/tables/2017/2017housing%20table%20Pennsylvania.pdf



23

Outline

- Goal
- History & Context
- Introduction to 8 Healthy Home Principles
- Healthy Home Upgrades



<https://bookstore.gpo.gov/products/2020-healthy-homes-calendar>



24

Building Performance Institute (BPI) Healthy Housing Principles

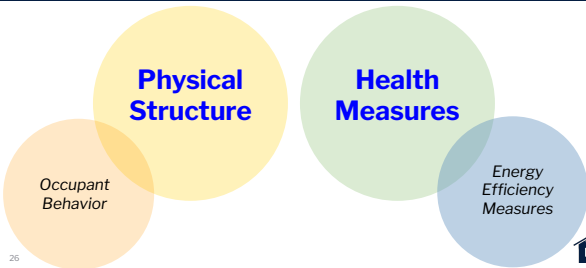
1. Keep it... **Clean**
2. Keep it... **Dry**
3. Keep it... **Pest-Free**
4. Keep it... **Contaminant-Free**
5. Keep it... **Safe**
6. Keep it... **Ventilated**
7. Keep it... **Comfortable**
8. Keep it... **Maintained**



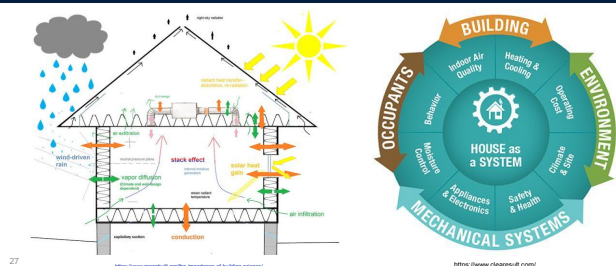
www.bpi.org/healthy-housing-principles



Focus Today



House as a System





1. Keep it ... Clean

Goal | Reduce exposure to:

- **dust**
- **allergens**
- **bacteria**
- **dust mites**
- **pests**



<https://thehealthyhouse.com/articles/keepit>



28



1. Keep it ... Clean

Outdoor Sources (~60%)

- Pollens
- Mold spores
- Smog particles
- Heavy metals
- Pesticides
- Pollutants
- Dirt



<https://thehealthyhouse.com/articles/keepit>

Indoor Sources (~40%)

- Fine particles (cooking, old paint, etc.)
- Household chemicals
- Fire retardants
- Perfluorocarbons (non-stick pan coatings)
- Pet dander



29



1. Keep it ... Clean



www.pac-plumbing.com/how-often-should-i-change-my-filter/



BEFORE



AFTER

<https://www.all-starheating.com/duct.html>



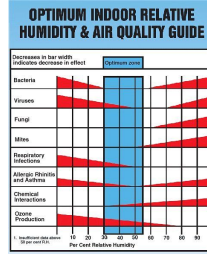
30



2. Keep it ... Dry

Goals

- 1) Keep **exterior moisture** from getting in
- 2) Keep **interior moisture** at comfortable level



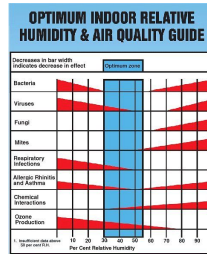
31



2. Keep it ... Dry

In Pennsylvania,

- **17.1%** of houses have **outdoor water leaks**
- **8.2%** of houses have **indoor water leaks**
- **2.7%** reported **mold** in the last 12 months

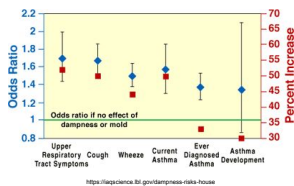


32


Source: 2019 American Housing Survey.



2. Keep it ... Dry



33



2. Keep it ... Dry

KEEP IT DRY

Moisture Sources



1. Bulk Water
2. Water Vapor

Bulk Moisture:
Rain, Snow, Ice

Bulk Moisture:
Condensation


Water Vapor:
Occupants, Cooking, Bathing

Water Vapor:
Seasonal RH

34

Image credit: Brian Wolfgang

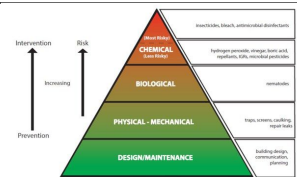


3. Keep it ... Pest-Free

KEEP IT PEST-FREE

Goal | Reduce exposure to disease & allergens due to:

- rodents
- cockroaches
- dust mites
- bed bugs




Pyramid of IPM Tactics Inside Buildings

Penn State College of Agricultural Sciences Penn State Department of Agriculture

<https://www.psu.edu/news-and-media/penn-state-college-of-agricultural-sciences/department-of-agriculture>


35



3. Keep it ... Pest-Free

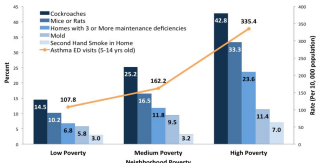
KEEP IT PEST-FREE

Asthma Triggers



<https://www.nichd.org/blog/just-breathe>

Asthma ED linked to housing condition



Source: NYC Environmental Health Tracking Portal, Department of Health and Mental Hygiene

36

4. Keep it ... Contaminant-Free

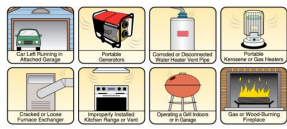
**KEEP IT
CONTAMINANT-**

Goal | Reduce exposure to:

- **combustion gas**, including **CO**
- **fine & ultrafine particulates**
- **volatile organic compounds (VOCs)**, including **formaldehyde**
- **lead**
- **tobacco smoke**
- **phthalates**
- **perfluorocarbons**
- **fire retardants**
- **pesticides**



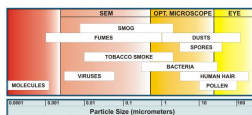
www.springfieldbuilders.com/seville-builders-bio06/Products+Indoor+Air+Pollution



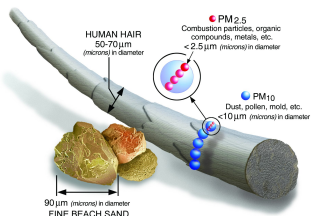


**KEEP IT
CONTAMINANT-
FREE**

4. Keep it ... **Contaminant-Free**



https://nmlms.fema.gov/a_0156/groups/292.html



www.epa.gov/sites/production/files/2016-09/item25_scale_graphic_color_2.jpg



38



**KEEP IT
CONTAMINANT-
FREE**

4. Keep it ... Contaminant-Free

Volatile Organic Compounds

 <p>BUILDING MATERIALS</p> <ul style="list-style-type: none"> • carpets & adhesives • sealing caulk • paint • composite wood products • upholstery fabrics • solvents • varnishes • vinyl flooring 	 <p>HOME & PERSONAL PRODUCTS</p> <ul style="list-style-type: none"> • air fresheners • fuel & gasoline • cosmetics • tissue-producing products • cleaning products • moth balls • vehicle exhaust 	 <p>FUELS & MACHINERY</p> <ul style="list-style-type: none"> • cooking • dry cleaning • photocopiers • space heaters • dry cleaning • tobacco smoke • wood-burning stoves • weed-paint & chemicals
--	--	--

www.allergyconsumerreview.com/what-is-yvc.html

Formaldehyde



www.indoordoctor.com/test-formaldehyde/



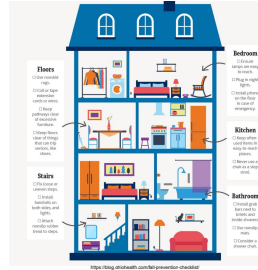
35



5. Keep it ... Safe

Goal | Prevent injuries from:

- **falls**
- **fire & burns**
- **poisoning (including CO)**
- **drowning**





5. Keep it ... Safe

- **1 in 4** people over 65 years old fall **every year**
- Falls are **29%** of preventable deaths in the home





5. Keep it ... Safe

In Pennsylvania,

- **28%** of homes missing a **CO detector**
- **18%** reported **mice or rats** in last 12 months

Source: 2019 American Housing Survey.

<https://support.homes.com/articles/prepare-for-smoke-alarm-co-alarm-and-fire-extinguishers>



- ▲ **Smoke & Fire Alarm**
One on every level and in every bedroom
- CO **Carbon Monoxide Alarm**
One on every level and in every bedroom
- **Fire Extinguisher**
One on every level, plus kitchen and garage





6. Keep it ... Ventilated



<https://www.energyvanguard.com/blog/do-you-really-need-run-bath-fan-winter/>



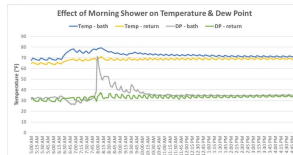
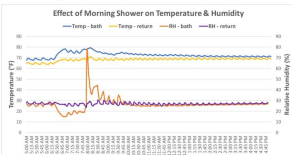
www.hgtv.com/design/remodel/tutorials/remodel/bathroom-mold-issues

46





6. Keep it ... Ventilated



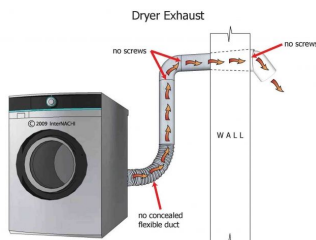
www.energyvanguard.com/blog/do-you-really-need-run-bath-fan-winter/

47





6. Keep it ... Ventilated



www.nachi.org/inspecting-dryer-exhaust.htm

48





KEEP IT
VENTILATED

6. Keep it ... Ventilated

5 things you should know about RADON:

- It's the #1 cause of lung cancer in non-smokers in the U.S.
- It's found everywhere in Pennsylvania.
- Testing is the only way to know if your home is at risk.
- Testing is easy and inexpensive.
- 40 % of Pa. homes have radon levels above recommended safe levels.

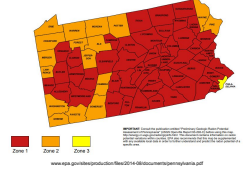


For more information visit
www.dep.pa.gov/radon or call
1.800.23.RADON.

How this material was prepared: Pennsylvania Department of Environmental Protection, Office of Environmental Health Assessment, 2017. All rights reserved. No part of this publication may be reproduced without prior written permission from the Department of Environmental Protection.

PENNSYLVANIA - EPA Map of Radon Zones

The map shows radon potential zones in Pennsylvania. The map is based on radon potential zones in Pennsylvania. The map is based on radon potential zones in Pennsylvania. The map is based on radon potential zones in Pennsylvania.



KEEP IT
VENTILATED

6. Keep it ... Ventilated

5 things you should know about RADON:

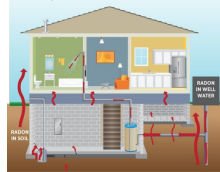
- It's the #1 cause of lung cancer in non-smokers in the U.S.
- It's found everywhere in Pennsylvania.
- Testing is the only way to know if your home is at risk.
- Testing is easy and inexpensive.
- 40 % of Pa. homes have radon levels above recommended safe levels.



For more information visit
www.dep.pa.gov/radon or call
1.800.23.RADON.

How this material was prepared: Pennsylvania Department of Environmental Protection, Office of Environmental Health Assessment, 2017. All rights reserved. No part of this publication may be reproduced without prior written permission from the Department of Environmental Protection.

Ways radon can enter the home



KEEP IT
COMFORTABLE

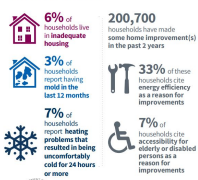
7. Keep it ... Comfortable

Goals | Maintain safe & healthy thermal comfort conditions, including:

- temperature
- relative humidity
- air movement

AMERICAN HOUSING SURVEY 2017 RESULTS // STATE OF PENNSYLVANIA

Housing Quality





7. Keep it ... Comfortable



www.hugoboss.com/health/haus-patient-schlagan-freisetzung-herzinfarkt-winter-2012-02-16.html



www.cnn.com/2012/02/02/health/haus-winter-kdrn-patient-schlagan-ohio-ide-charge/haus.html



7. Keep it ... Comfortable

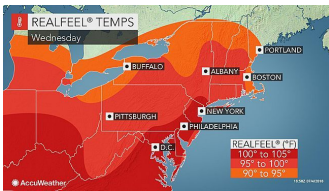
HEAT EXHAUSTION
Slight or dizzy
Dizziness, sweating
Cool, pale, clammy skin
Nausea or vomiting
Rapid, weak pulse
Muscle cramps

HEAT STROKE
Fainting, headache
No sweating
Body temperature above 103°
No pulse, dry skin
Nausea or vomiting
Rapid, strong pulse
May lose consciousness

CALL 9-1-1

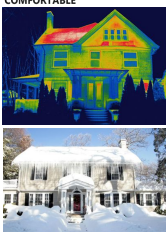
- Get to a cooler, air-conditioned place
- Drink water if fully conscious
- Take to cool shower or use cool compresses
- Take immediate action to cool the person until help arrives

www.weather.gov/indianapolis/heat_illness.pdf





7. Keep it ... Comfortable

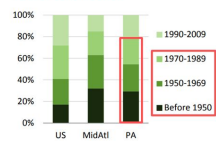


Household Energy Use in Pennsylvania

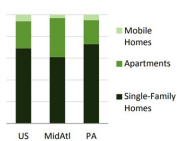
A closer look at residential energy consumption

All data from EPA's 2009 Residential Energy Consumption Survey
www.eia.gov/consumption/residential/

YEAR OF CONSTRUCTION



HOUSING TYPES



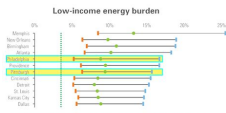
U.S. Energy Information Administration (EIA). (2013). Household Energy Use in Pennsylvania. Retrieved from http://www.eia.gov/consumption/residential/reports/2009/States_2mwh/ypt/ps.pdf

AVERAGE SQUARE FOOTAGE	US	1,971
	MidAtI	2,080
	PA	2,240



7. Keep it ... Comfortable

KEEP IT COMFORTABLE



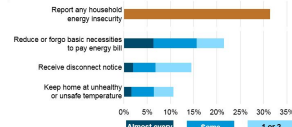
Philadelphia low-income energy burden 8.82% median

Pittsburgh low-income energy burden 9.42% median

Drexel, Aron & Ross, Lauren. *Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low Income and Underserved Communities*. ACEEE, April 2018.

RESIDENTIAL ENERGY CONSUMPTION SURVEY (RECS)

Households experiencing household energy insecure situations, 2015 percent of households



Source: U.S. Energy Information Administration, Residential Energy Consumption Survey 2015



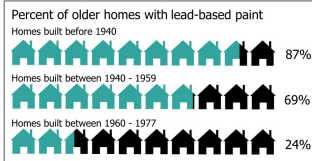


8. Keep it ... Maintained

KEEP IT MAINTAINED

Goals | Prevent & remove potential hazards, including:

- lead
- asbestos
- radon
- water leaks
- HVAC & electrical system checks



<https://www.epa.gov/lead/paint-lead-older-homes>





8. Keep it ... Maintained

KEEP IT MAINTAINED



<http://buffalocountygutter.com/water-damage-from-gutter-problems/>



www.pac-plumbing.com/how-often-should-i-change-my-filter/



Building Performance Institute (BPI) Healthy Housing Principles

1. Keep it... **Clean**
2. Keep it... **Dry**
3. Keep it... **Pest-Free**
4. Keep it... **Contaminant-Free**
5. Keep it... **Safe**
6. Keep it... **Ventilated**
7. Keep it... **Comfortable**
8. Keep it... **Maintained**



www.bpi.org/healthy-housing-principles



58

Outline

- Goal
- History & Context
- Introduction to 8 Healthy Home Principles
- Healthy Home Upgrades



<https://bookstore.gpo.gov/products/2010-healthy-homes-calendar>



59

Healthy Home Upgrades

1. Maintenance projects using the **Healthy Home Maintenance Checklist**
2. Use healthy materials
3. Ventilation upgrades
4. Cooking upgrades
5. Energy efficiency upgrades
6. Fall prevention reviews



<https://bookstore.gpo.gov/products/2010-healthy-homes-calendar>



60



2. Use Healthy Materials

Volatile Organic Compounds



BUILDING MATERIALS

- carpets & adhesives
- sealing caulk
- paint
- composite wood products
- upholstery fabrics
- solvents
- varnishes
- vinyl flooring



HOME & PERSONAL PRODUCTS

- air fresheners
- fuel oil & gasoline
- cosmetics
- ozone-producing products
- cleaning products
- moth balls
- vehicle exhaust



FUELS & MACHINERY

- cooking
- dry cleaning
- photocopiers
- space heaters
- dry cleaning
- tobacco smoke
- wood-burning stoves
- stored paint & chemicals

www.allergyconsumerreview.com/what-is-voc.html



Formaldehyde

www.indoordoctor.com/test-formaldehyde/



64



2. Use Healthy Materials

Print Available Location or Address (If you are not a resident of the United States, please print your foreign address.)	<h1>Declare.</h1>
Estimated Gross Income (If you are not a resident of the United States, please print your foreign gross income.)	
Estimated Net Income (If you are not a resident of the United States, please print your foreign net income.)	Product Name Manufacturer
Estimated Sales Tax (If you are not a resident of the United States, please print your foreign sales tax.)	Product Description (If you are not a resident of the United States, please print your foreign product description.)
Estimated Shipping and Handling (If you are not a resident of the United States, please print your foreign shipping and handling.)	Product Code (If you are not a resident of the United States, please print your foreign product code.)
Estimated Total (If you are not a resident of the United States, please print your foreign total.)	Product Name Manufacturer
Estimated Gross Income (If you are not a resident of the United States, please print your foreign gross income.)	Product Description (If you are not a resident of the United States, please print your foreign product description.)
Estimated Net Income (If you are not a resident of the United States, please print your foreign net income.)	Product Code (If you are not a resident of the United States, please print your foreign product code.)
Estimated Sales Tax (If you are not a resident of the United States, please print your foreign sales tax.)	Product Name Manufacturer
Estimated Shipping and Handling (If you are not a resident of the United States, please print your foreign shipping and handling.)	Product Description (If you are not a resident of the United States, please print your foreign product description.)
Estimated Total (If you are not a resident of the United States, please print your foreign total.)	Product Code (If you are not a resident of the United States, please print your foreign product code.)

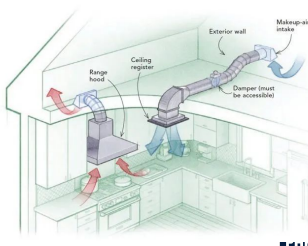
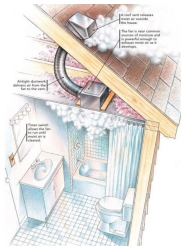
<https://living-future.org/declare/declare-about/>



65



3. Ventilation Upgrades



www.finehomebuilding.com/2002/06/01/building-a-bathroom-fan

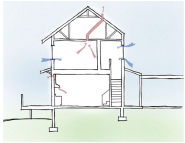
www.greenbuildingadvisor.com/article/make-up-air-for-kitchen-exhaust



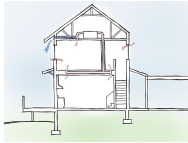
66



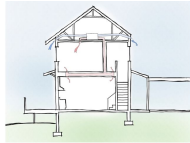
3. Ventilation Upgrades



Source: Residential Range Hood & Cook-Top Design, Ventilation Source & Requirements, Better Buildings



Source: Residential Range Hood & Cook-Top Design, Ventilation Source & Requirements, Better Buildings



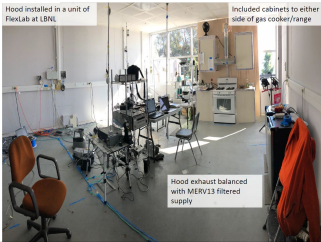
Source: Residential Range Hood & Cook-Top Design, Ventilation Source & Requirements, Better Buildings

67





Smart Range Hood (SRH) Pilot



68

SRH Design Objectives & Phases

Smart Range Hood

Quiet	Efficient Pollutant Capture	Energy Efficient	Sensor Driven Controls
≤ 1 score when at a flow rate less than 150 cfm	≥ 90% capture efficiency	Fan efficiency exceeding 0.5 scores ENERGY STAR minimum	Auto sense and response to cooking pollutants

Better Buildings Residential Network Peer Exchange Call Series. (2021, March 21) Smart Range Hoods vs. Indoor Air Quality: Coming Soon to Kitchens Near You. US Department of Energy.





3. Ventilation Upgrades



<https://www.familyhandyman.com/article/radon-gas-remediation-the-best-radon-mitigation-systems/>

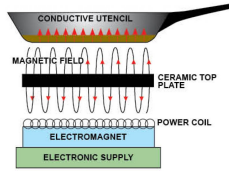
69





KEEP IT
CONTAMINANT-
FREE

4. Cooking Upgrades



www.kitchenmagazine.com/induction-cooking-why-for-health



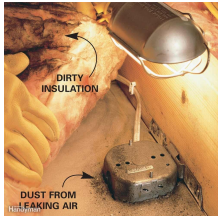
70

www.greenbuildingtechnician.com/benefits-induction-cooking-for-your-kitchen



KEEP IT
COMFORTABLE

5. Energy Efficiency Upgrades



Common Weatherization Upgrades	These upgrades mitigate indoor asthma triggers by...	Indoor Asthma Triggers Addressed
<ul style="list-style-type: none">Air sealingInsulationHeating system replacement/maintenance/filtersAC system replacement/maintenanceMechanical ventilationWindow replacement/repairDryer ventingHealth & safety testing and measuresGround vapor barrier	<ul style="list-style-type: none">Regulating indoor temperature and humidityRemoving indoor asthma triggersCreating and strengthening barriers to outdoor triggers	<ul style="list-style-type: none">Pollutants from vehicle traffic (e.g., diesel exhaust)Infiltration of ozone and other criteria pollutantsInfiltration of outdoor allergensMolds and fungiIndoor VOCsCockroach, dust mite, and rodent allergensThermal stress (extreme temps indoors)NO₂ and particulate matter from stoves

Figure 2. Common weatherization upgrades and asthma mitigation benefits
ACEEE. Protecting the Health of Vulnerable Populations with In-Home Energy Efficiency: A Survey of Methods for Demonstrating Health Outcomes (October 2019)



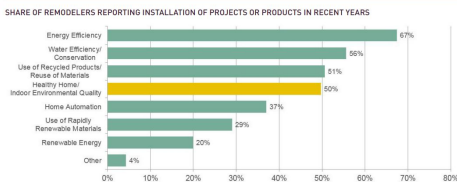
71 www.familyhandyman.com/fact25-things-you-need-to-know-about-insulation/



KEEP IT
COMFORTABLE

5. Energy Efficiency Upgrades

FIGURE 8: HALF OF REMODELERS REPORTED INSTALLING HEALTHY HOME PROJECTS IN RECENT YEARS



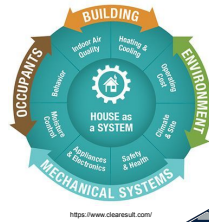
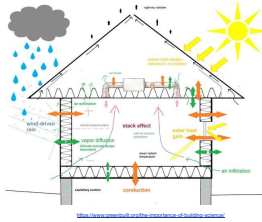
Notes: Remodelers were asked, "Which of the following categories describe remodeling projects and/or products that your company has installed in recent years?" Sample size is 379.
Source: Remodelers' Stress and Job-Career Remodeling Contractor Healthy Home Survey August 2019

72

www.jchs.harvard.edu/research-areas/research-briefs/healthy-home-remodeling-consumer-trends-and-contractor-preparedness



5. Energy Efficiency Upgrades





5. Energy Efficiency Upgrades

Table 1. Monetized health benefit potential from select in-home interventions, in 2019 dollars

	Nationwide total after one year	Nationwide total after 10 years
Reduced trip-and-fall injuries	\$177,200,000	\$2,180,000,000
Reduced asthma symptoms	\$38,500,000	\$593,000,000
Reduced heat-related thermal stress	\$8,000,000	\$73,000,000
Reduced cold-related thermal stress	\$4,600,000	\$41,000,000
Total monetized health benefits from four targeted interventions	\$228,000,000	\$2,888,000,000

ACEEE. Making Health Count: Monetizing the Health Benefits of In-Home Services Delivered by Energy Efficiency Programs. (May 2020)





6. Fall Prevention Reviews



Source: SPI Healthy Homes Training

www.BehavioRx.com/HealthyHomes/HealthyHomesToolbox

Healthy Home Upgrades

1. Maintenance projects using the Healthy Home Maintenance Checklist
2. Use healthy materials
3. Ventilation upgrades
4. Cooking upgrades
5. Energy efficiency upgrades
6. Fall prevention reviews



<https://bookstore.gpo.gov/products/2010-healthy-homes-calendar>



76

Outline

- Goal
- History & Context
- Introduction to 8 Healthy Home Principles
- Healthy Home Upgrades

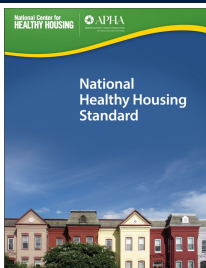


<https://bookstore.gpo.gov/products/2010-healthy-homes-calendar>



77

Goal: Build Awareness



KEEP IT CLEAN



KEEP IT DRY



KEEP IT PEST-FREE



KEEP IT CONTAMINANT-FREE



KEEP IT SAFE



KEEP IT VENTILATED



KEEP IT COMFORTABLE



KEEP IT MAINTAINED

www.bpl.org/healthy-housing-principles

<https://nchh.org/resource-library/national-healthy-housing-standard.pdf>



78



Questions?

www.phrc.psu.edu

79