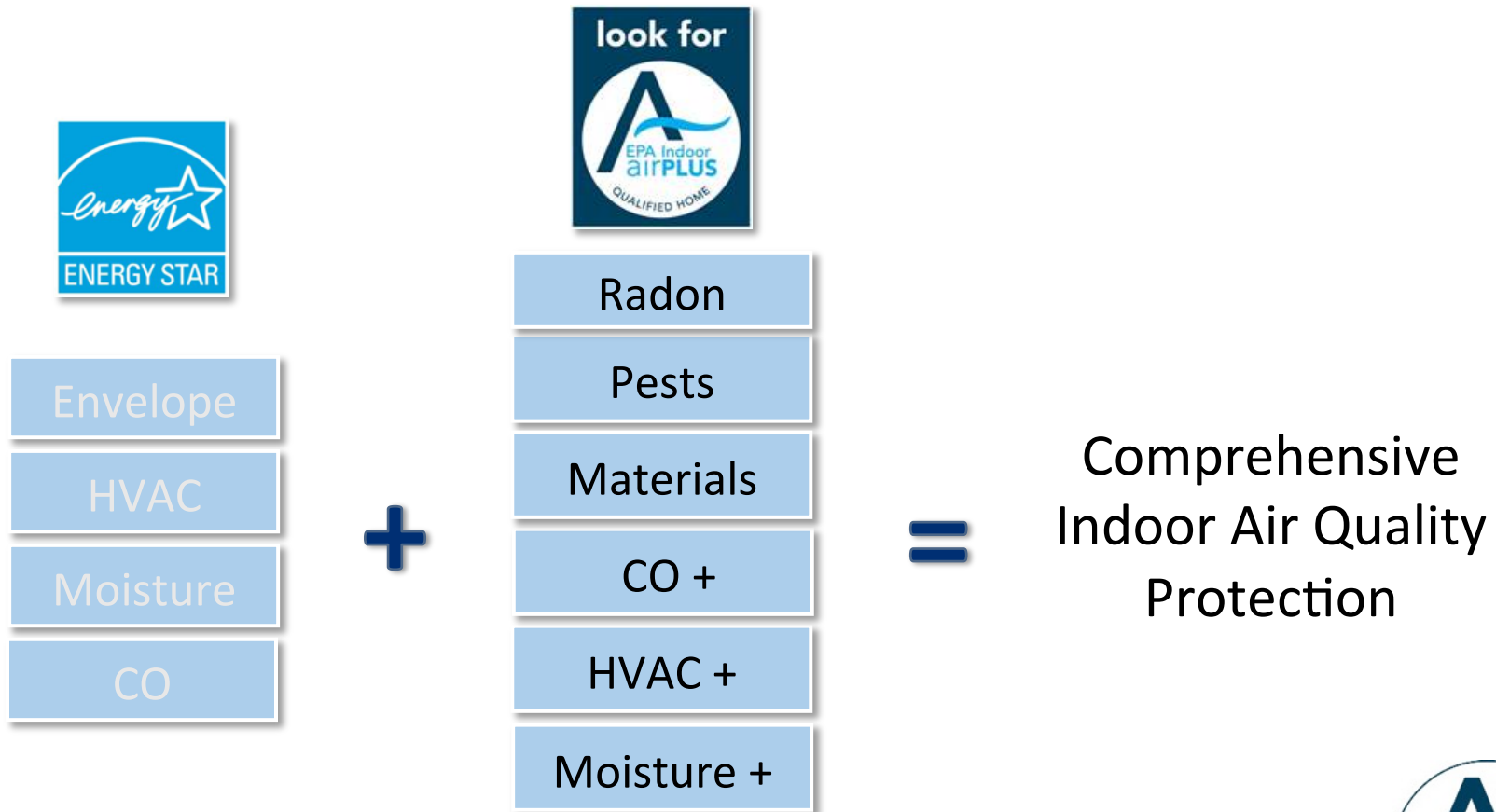


Avoiding Indoor airPLUS Pitfalls for Your PHIUS Projects

VERSION 1 (REV. 03)



ENERGY STAR + Indoor airPLUS



Indoor airPLUS adds additional health protections to your ENERGY STAR value proposition

Indoor Air Quality (IAQ)

High-Performance Home Staircase



Indoor airPLUS + PHIUS+

Indoor airPLUS qualification can help ensure that tight passive homes do not contribute to unhealthy living environments.

Compatible program values and certification processes:

- Both programs are based on building science principles that use a systems approach to improve home performance issues.
- Both programs require completion of verification checklists by a qualified Home Energy Rater (additional training required for PHIUS).
- Visual inspection items can be verified during the same on-site visits.

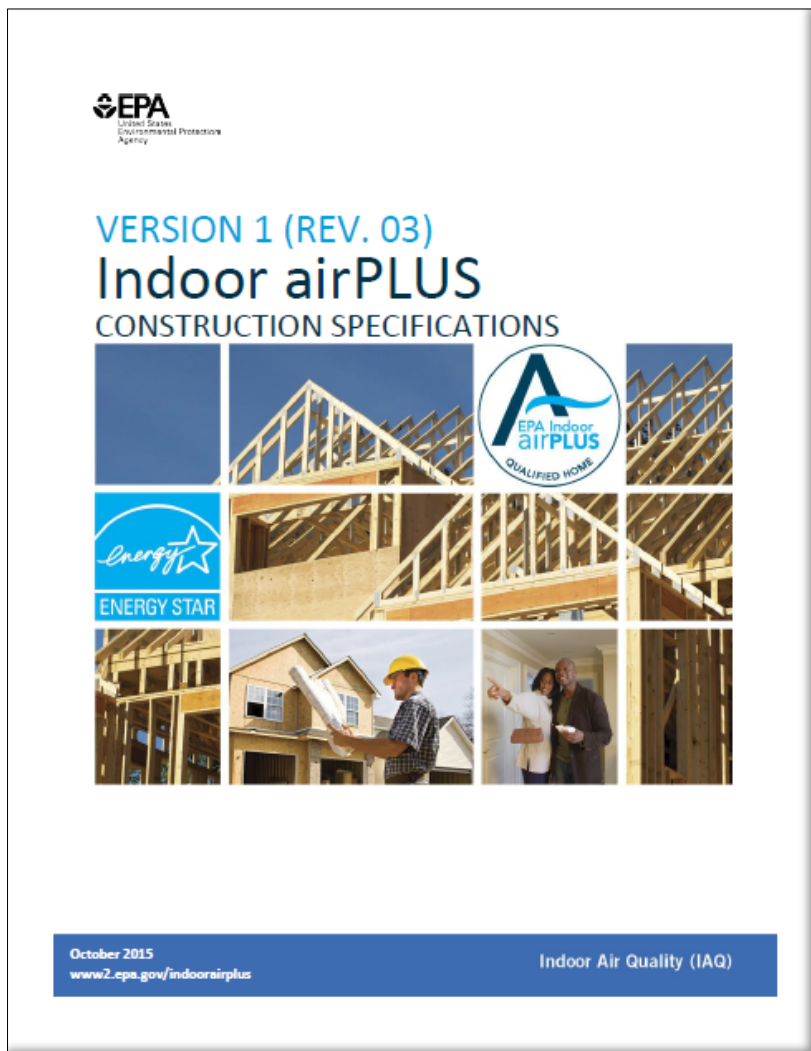


Ensuring Multi-Certification Success

- Get started early – integrate IAP features at the pre-planning and design phases.
- Identify a Home Energy Rater who has training/experience with both IAP and PHIUS+.
 - PHIUS consultants are encouraged to participate in IAP webinars and review online resources to learn more about the program.
<https://www.epa.gov/indoorairplus>
- Reach out to Rater, Provider, or EPA ([Indoor airPLUS@epa.gov](mailto:Indoor_airPLUS@epa.gov)) with technical and programmatic questions.



Revision 3



- Released October 2015.
- Further alignment with ENERGY STAR Rev. 8.
- Clarified multiple requirements.
- Provided additional advisories (e.g adhesives & sealants).
- Updated list of compliant products for Section 6 and developed a new resource, [*How to Find Indoor airPLUS Compliant Low Emission Products.*](#)



Indoor airPLUS Categories

1. Moisture Control

1.1 Site and Foundation Drainage

NOTE: Completion of the [ENERGY STAR requirements](#) now satisfies the following Indoor airPLUS requirements:

- ✓ *Slope patio slabs, walks and driveway; tamp back-fill to prevent settling; AND slope the final grade away from the foundation (Builder-W 1.1 and 1.2).*
- ✓ *Swales or drains designed to carry water away from the foundation are permitted to be provided as an alternative to the slope requirements for any home, and shall be provided for a home where setbacks limit space to less than 10 ft. (Builder-W 1.1 and 1.2).*
- ✓ *Install protected drain tile at the footings of basement and crawlspace walls. Surround each drain tile pipe with washed or clean gravel wrapped with fabric cloth, or install an approved Composite Foundation Drainage System (CFDS) (Builder-W 1.8).*

Additional Indoor airPLUS Requirements:

- Install a drain or sump pump in basement and crawlspace floors, discharging to daylight at least 10 ft. outside the foundation or into an approved sewer system.

Exceptions:

- Slab-on-grade foundations.
- In areas of free-draining soils — identified as Group 1 (Table R405.1, 2009 IRC) by a certified hydrologist, soil scientist, or engineer through a site visit — installation of a drain or sump pump is not required.
- In EPA Radon Zone 1, if a drain tile discharges to daylight install a check valve at the drain tile outfall (see Specification 2.1).

- Seven sections:
 - ★ • Moisture Control
 - ★ • Radon Control
 - Pests
 - HVAC Systems
 - ★ • Combustion Pollutants
 - ★ • Materials
 - ★ • Home Commissioning



How to use the Construction Specifications

4.7 Filtration for Central Forced-Air HVAC Systems

NOTE: Completion of the [ENERGY STAR requirements](#) now satisfies the following Indoor airPLUS requirement:

- ✓ Equip all filter access panels with gasket material or comparable sealing mechanism and ensure access panels fit snugly against the exposed edge of the installed filter when closed to prevent bypass (Rater-F 9.3).

Additional Indoor airPLUS Requirements:

- Install only HVAC filters that are rated MERV 8 or higher according to ASHRAE 52.2-2007 (at approximately 295 fpm).

Advisory: Filters perform best when the filter rack design includes the following features, which are also included in some manufacturers' filter media boxes:

- Flexible, air-tight (e.g., closed-cell foam) gasket material on the surface that contacts the air-leaving (downstream) side of the filter.
- Friction fit or spring clips installed on the upstream side of the filter to hold it firmly in place.
- Upon installation of the air handling unit, include a filter for the remainder of construction activity to protect the unit and/or coil from construction debris and dust. Filter should be clean upon final inspection following construction (see Specification 7.1).

Advisory: To reduce the likelihood of construction dust contaminating the ducts and air handler, limit use of the HVAC system during activities with increased dust (e.g. drywall sanding, floor sanding).

- Do not install any air-cleaning equipment designed to produce ozone (i.e., ozone generators).

- Relevant ENERGY STAR checklist items are summarized and referenced at the beginning of each measure.
- Additional Indoor airPLUS requirements are listed separately. These include:
 - Items that provide additional indoor air quality protections.
 - Requirements that exclude an ENERGY STAR exception.
- Advisories, notes, and exceptions listed where applicable.



How to Complete the Verification Checklist

- ENERGY STAR certification is required to achieve Indoor airPLUS qualification.
- Check one box per line.
- Check “N/A” for specifications that do not apply for specific conditions (e.g., climate) according to the exceptions described.
- Check either “Builder Verified” or “Rater Verified” for all other items.

Home Address:		City:	State:	Zip:	
Section	Requirements (Refer to full Indoor airPLUS Construction Specifications for details)	Must Correct	Builder Verified	Rater Verified	N/A
	Note: The Rev. 03 checklist has been modified to reflect only the additional Indoor airPLUS requirements and their corresponding section numbers that must be met after completing the ENERGY STAR requirements. ENERGY STAR remains a prerequisite for Indoor airPLUS qualification.				
ENERGY STAR V3	ENERGY STAR Version 3 Program Requirements must be followed and the home shall be ENERGY STAR certified in conjunction with Indoor airPLUS qualification.	<input type="checkbox"/>		<input type="checkbox"/>	

Indoor airPLUS Checklist located within PHIUS+ Workbook

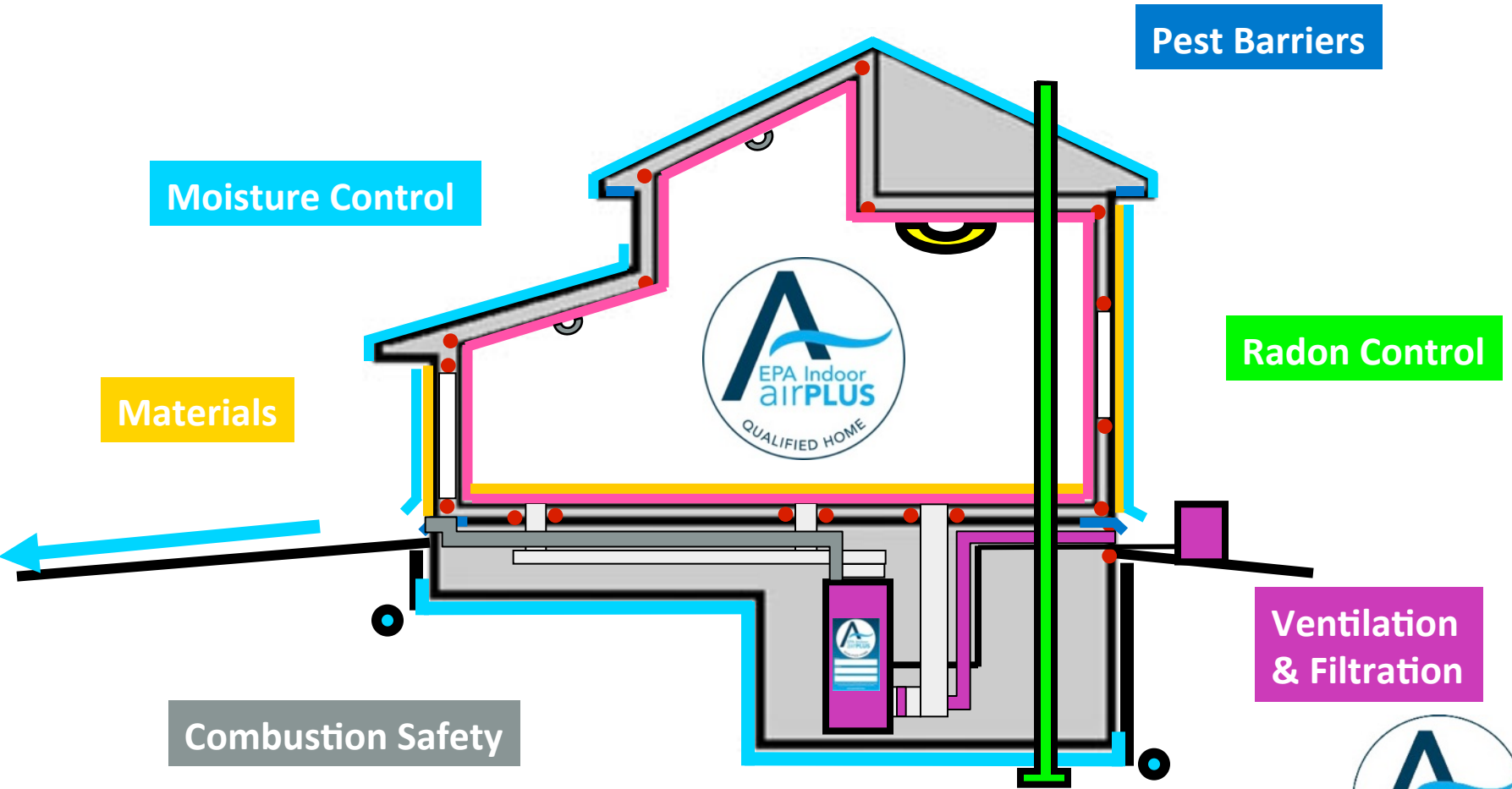
- Track IAP and PHIUS+ requirements side-by-side
- Extract worksheet when ready to submit for certification

PHIUS+ Quality Control Workbook v3.0.2 (3-13-14 revision date)

(project name)	(PHIUS+ registration #)
(street address)	(city)
(state/province)	(zip code)
(PHIUS+ Rater name)	(Rater Company Name)
(CPHC)	(Architect)
(Builder Company)	(Builder Responsible Party)
(HVAC company name)	(HVAC responsible party)
(building permit date)	(Building Air Tightness Index)
<input type="checkbox"/>	Rater Verified
<input type="checkbox"/>	Builder is Energy Star Partner
<input type="checkbox"/>	DOE Challenge Home Partner

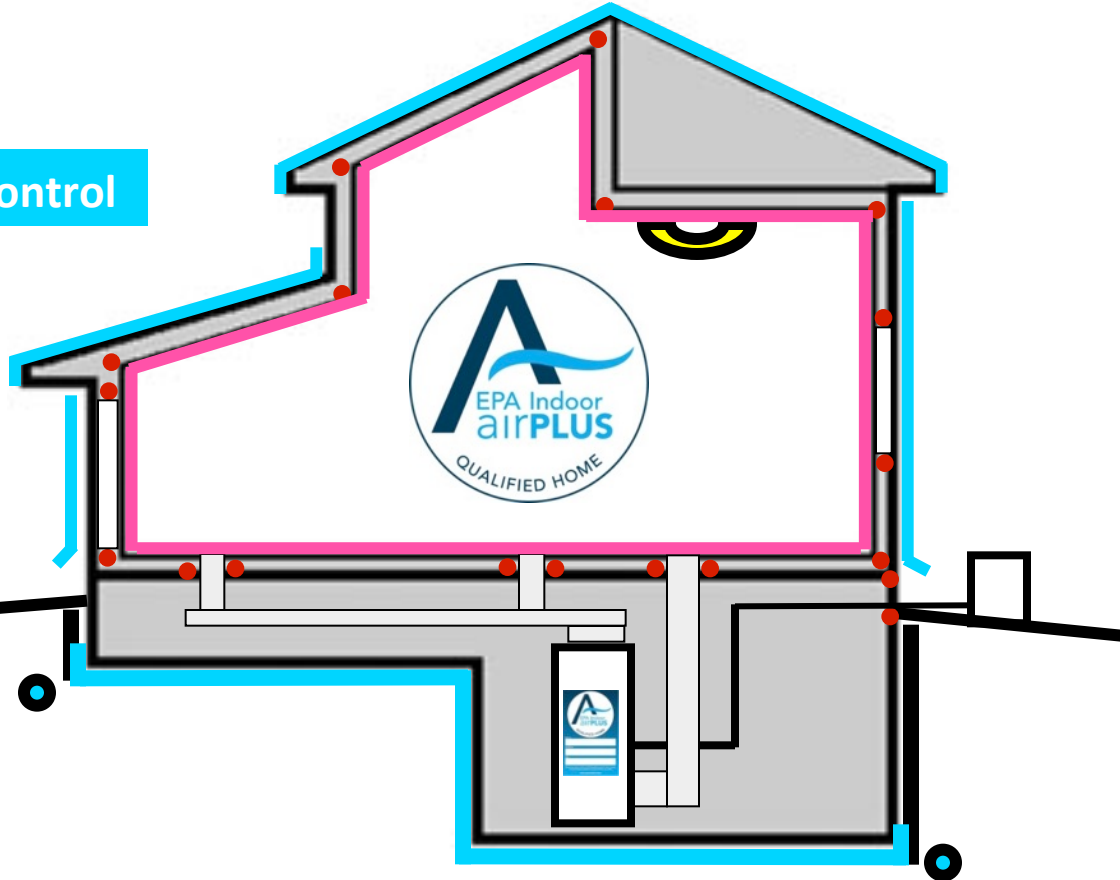
Passive House Institute US

Indoor airPLUS



1. Moisture Control

Moisture Control



1. Moisture Control



- Moisture is a leading cause of health, comfort and durability concerns in homes.
- 19% of U.S. households have at least one person with asthma.
- There is a 20-50% increased risk of asthma in damp houses.
- The economic cost of asthma amounts to more than \$56 billion annually.
- Mold grows where there is moisture.
- Molds produce allergens, irritants, and in some cases, potentially toxic substances.



1.1 Site and Foundation Drainage



- ✓ *Slope hard surfaces and final grade away from the foundation.*
- ✓ *Install drain tiles at the footings of basement and crawlspace walls.*
- Install a drain or sump pump in basement and crawlspace floors.
- Exception for free-draining soils.
- Check valve to be installed for homes in Radon Zone 1.



Resource for Assessing Soil Drainage

<http://websoilsurvey.nrcs.usda.gov/app/>

The screenshot displays the USDA Web Soil Survey interface. At the top, a dark red banner reads "Area of Interest (AOI)". Below this, the website header includes the USDA logo, "Natural Resources Conservation Service", and "Web Soil Survey". A navigation menu contains links for "Contact Us", "Download Soils Data", "Archived Soil Surveys", "Soil Survey Status", "Glossary", "Preferences", "Logout", and "Help". The main content area is divided into two panels. The left panel, titled "Area of Interest (AOI)", contains a search bar, "Open All" and "Close All" buttons, "AOI Properties" (with a "Clear AOI" button), "AOI Information" (with a "Name" field), "Map Unit Symbols" (with radio buttons for "Use Soil Survey Area Map Unit Symbols" and "Use National Map Unit Symbols"), "Area (acres)" (710.4), "Soil Data Available from Web Soil Survey" (Solano County, California (CA095)), "Spatial Data" (Version 1, Aug 27, 2004), "Tabular Data" (Version 5, Dec 12, 2007), "Clear AOI" button, "Import AOI", and "Export AOI" buttons. The right panel, titled "Area of Interest Interactive Map", shows a satellite map of Solano County, California, with a red AOI boundary. The map includes a legend, "View Extent" (Contiguous U.S.), "Scale" (1:33,500), and a scale bar (287.6ft). The bottom right corner of the screenshot features the EPA Indoor AirPLUS logo, which consists of a stylized blue 'A' inside a circle with the text "EPA Indoor airPLUS" below it.



Search

Area of Interest

Open All Close All

Legend

Save

View Extent Contiguous U.S. Scale (not to scale)

AOI Properties

Clear AOI

AOI Information

Name

Map Unit Symbols

- Use Soil Survey Area Map Unit Symbols
- Use National Map Unit Symbols

Area (acres) 0.24

Soil Data Available from Web Soil Survey

Berks County, Pennsylvania (PA011)

Data Availability Tabular and Spabial, complete

Tabular Data Version 11, Nov 16, 2015

Spabial Data Version 4, Dec 16, 2013

Clear AOI

Import AOI

Create AOI from Shapefile

Create AOI from Zipped Shapefile

Export AOI

Quick Navigation

Address

View

Address 57 pine swamp rd kempton pa

Show location marker

View

State and County

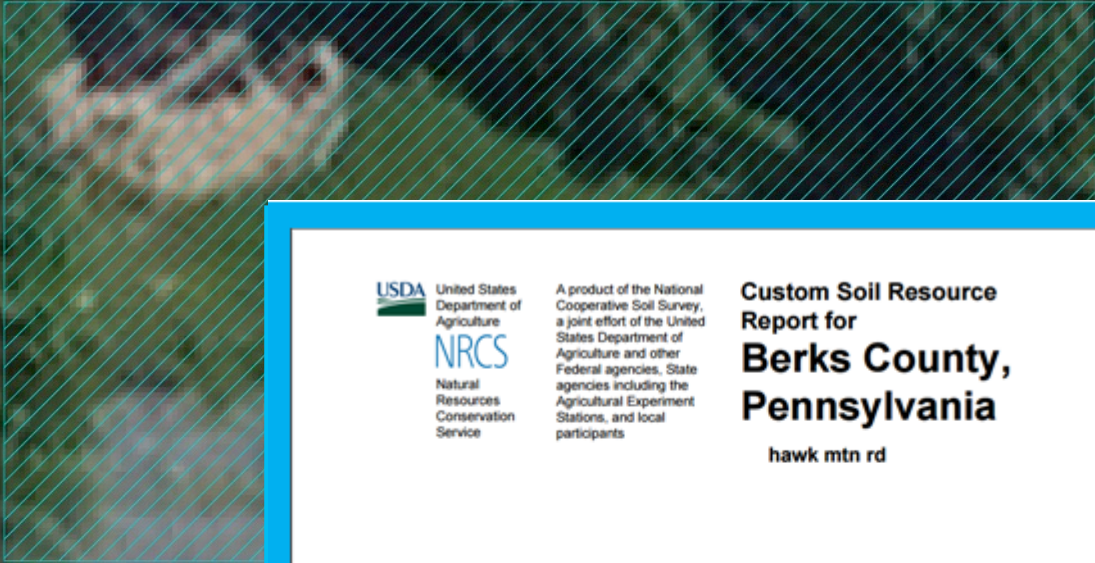
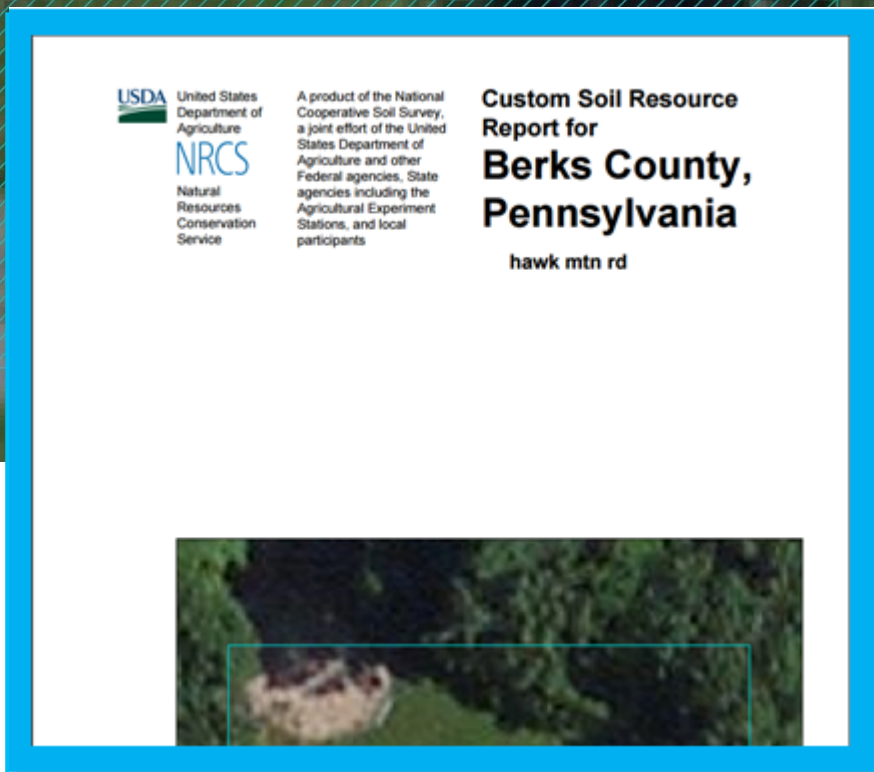
Soil Survey Area

Latitude and Longitude

PLSS (Section, Township, Range)

Bureau of Land Management

Department of Defense

USDA United States Department of Agriculture
NRCS Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Berks County, Pennsylvania

hawk mtn rd



1.3 & 1.4 Below-grade Foundation Walls

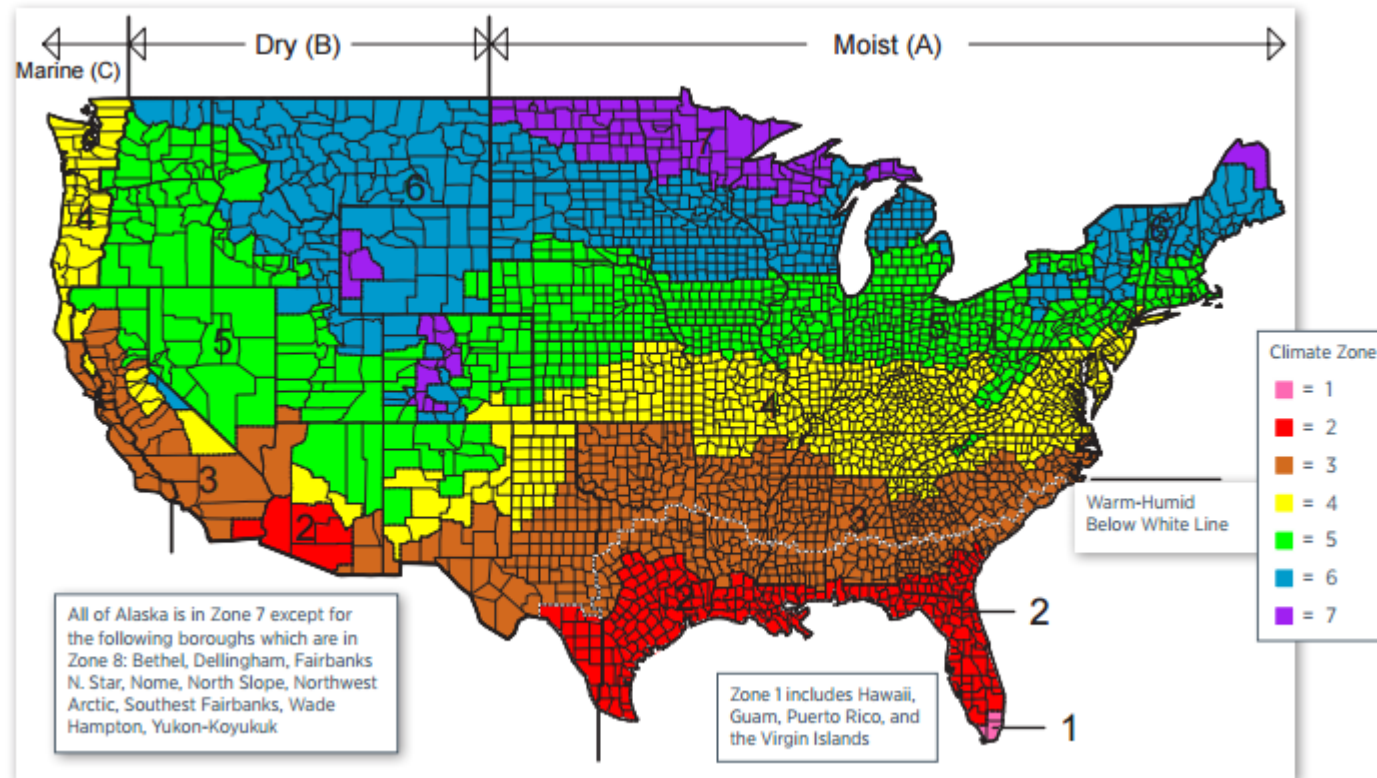


- ✓ *Waterproof crawlspace and basement perimeter walls.*
- ✓ *All floors above unconditioned spaces shall be insulated.*

- Insulate crawlspace and basement perimeter walls
- Seal crawlspace and basement perimeter walls
- Provide conditioned air by either
 - A dedicated supply (1 cfm per 50 square feet) OR
 - Crawl space exhaust (only in non-Radon zone 1)
- No exceptions for below-grade damp-proofing / water-proofing. Required for IAP label.
- No exception for basement conditioning based on load.
 - Exceptions for:
 - Location within flood zone
 - Raise pier foundation w/ no walls
 - Dry & marine climates



ICC Climate Zone Map



County-level information from DOE:
<http://energy.gov/eere/buildings/climate-zones>



FEMA Flood Map Service Center

Address-level tool: <https://msc.fema.gov/portal/search>



Navigation

Search

Languages

MSC Home

MSC Search by Address

MSC Search All Products

MSC Products and Tools

Hazus

LOMC Batch Files

Product Availability

MSC Frequently Asked Questions (FAQs)

MSC Email Subscriptions

Contact MSC Help

FEMA Flood Map Service Center : Search By Address

Enter an address, place, or coordinates: ?

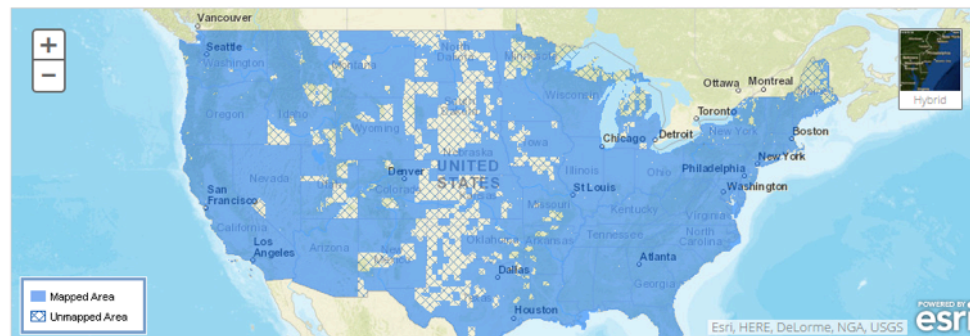
Enter an address, place, or coordinates

Search



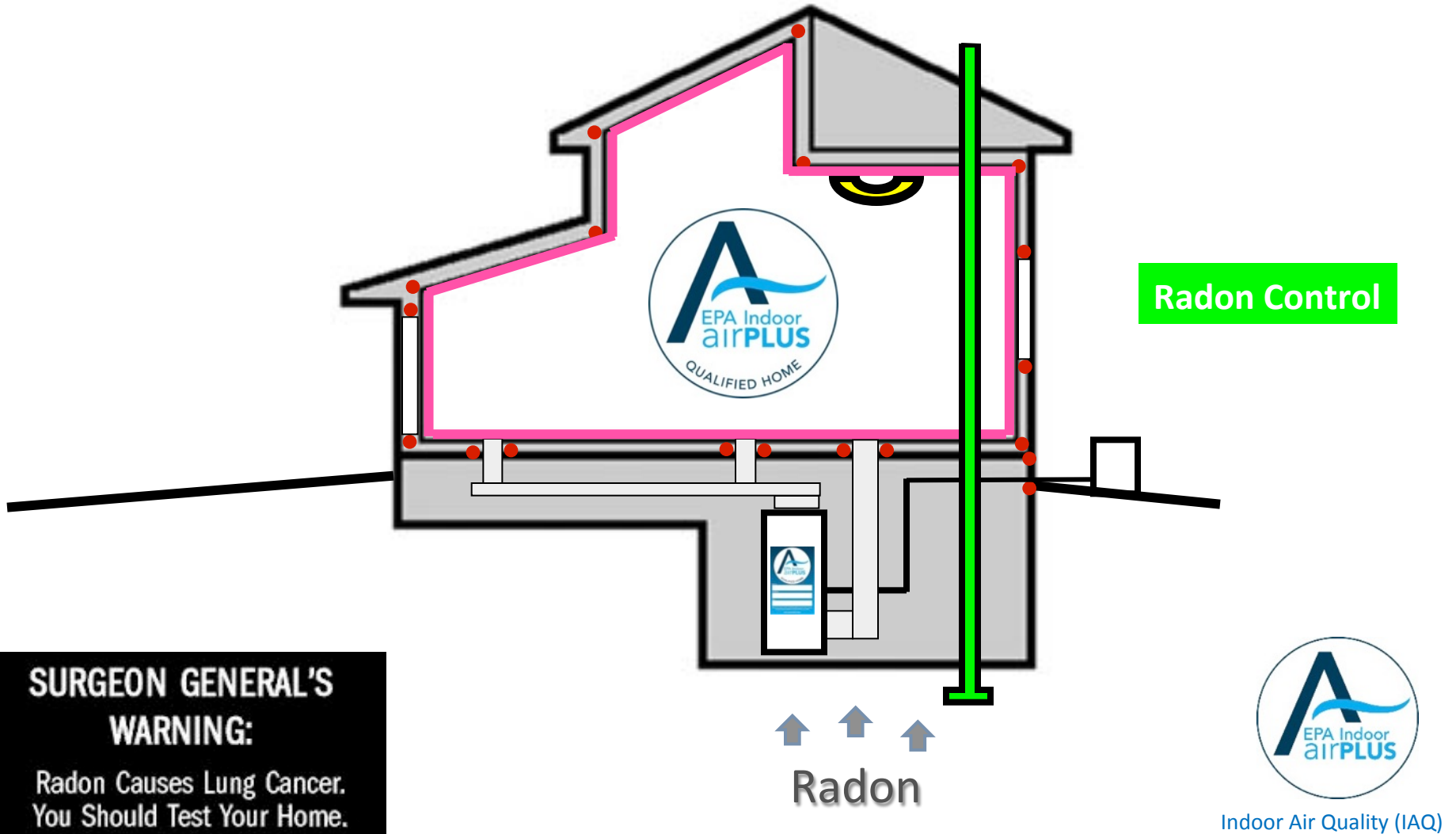
To find your flood map, enter an address, a place, or a set of longitude/latitude coordinates. The map will zoom in and show the boundaries of the flood map for the chosen location. You can also use the map to navigate to a place of interest using the pan and zoom functions. When a specific flood map is selected, view and download options for that map will appear.

Locator Map



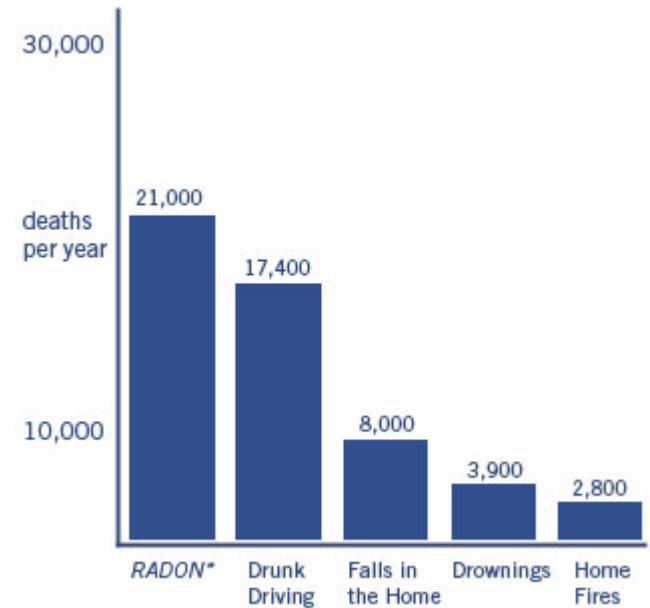
Indoor Air Quality (IAQ)

2. Radon



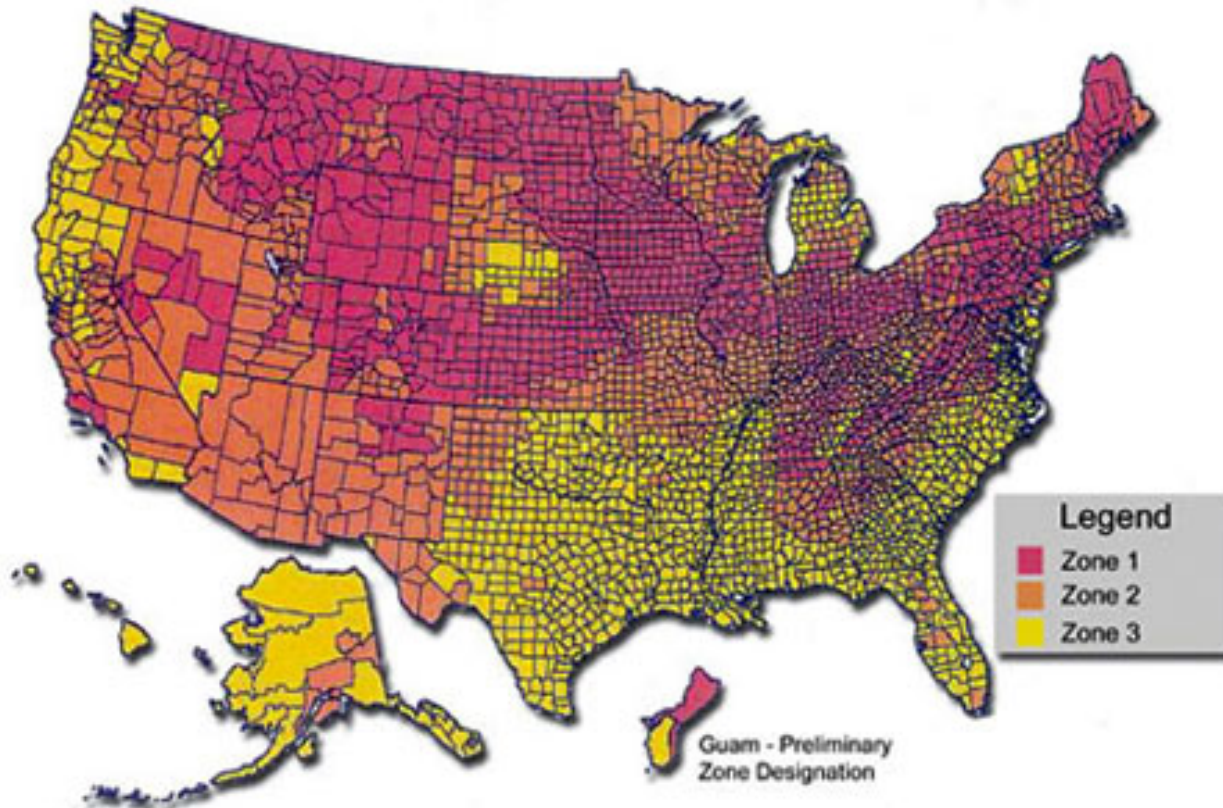
2. Radon

- Radon is a cancer-causing radioactive gas created by the natural breakdown of uranium in soil.
- Radon can be found all over the US.
- 1 in 15 homes have radon above 4 pCi/L.
- You are most likely to get your greatest exposure to radon at home.
- Radon is the second leading cause of lung cancer after smoking.



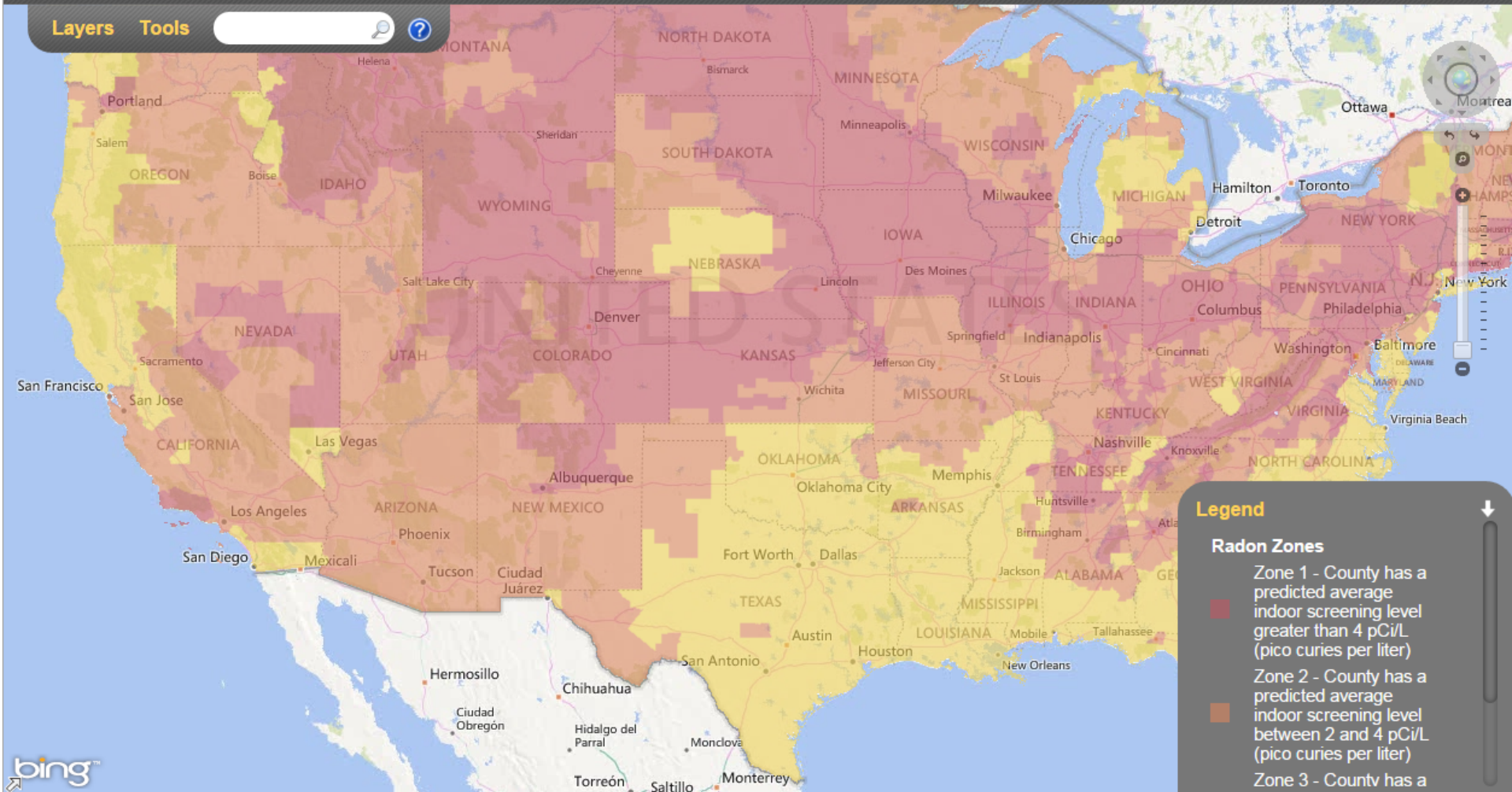
2.1 Radon Control

EPA Map of Radon Zones



Note: These maps indicate average risk by county. However, high levels of radon can be found in any home. See: www.epa.gov/radon/zonemap.html or for an interactive map, see: <http://www.wxplushealth.org/geoexplorer>.





Radon Zones – 1,2,3?

For an easy-to-use map: Weatherization Plus Health GeoExplorer
<http://www.wxplushealth.org/geoexplorer>



2. Radon

- Radon is an important concern for all home types:
 - Existing & new construction
 - Tightly-sealed & leaky homes
- Research has not yet been performed to evaluate whether passive construction affects radon mitigation
- Labeling programs take precautionary approach toward radon mitigation
- IAP specification only stipulates radon controls for homes within Zone 1
- Passive radon controls are sufficient; active systems not required
- Passive controls will not decrease the energy efficiency of the home



2.1 Radon Control



✓ *Air seal all sump covers.*



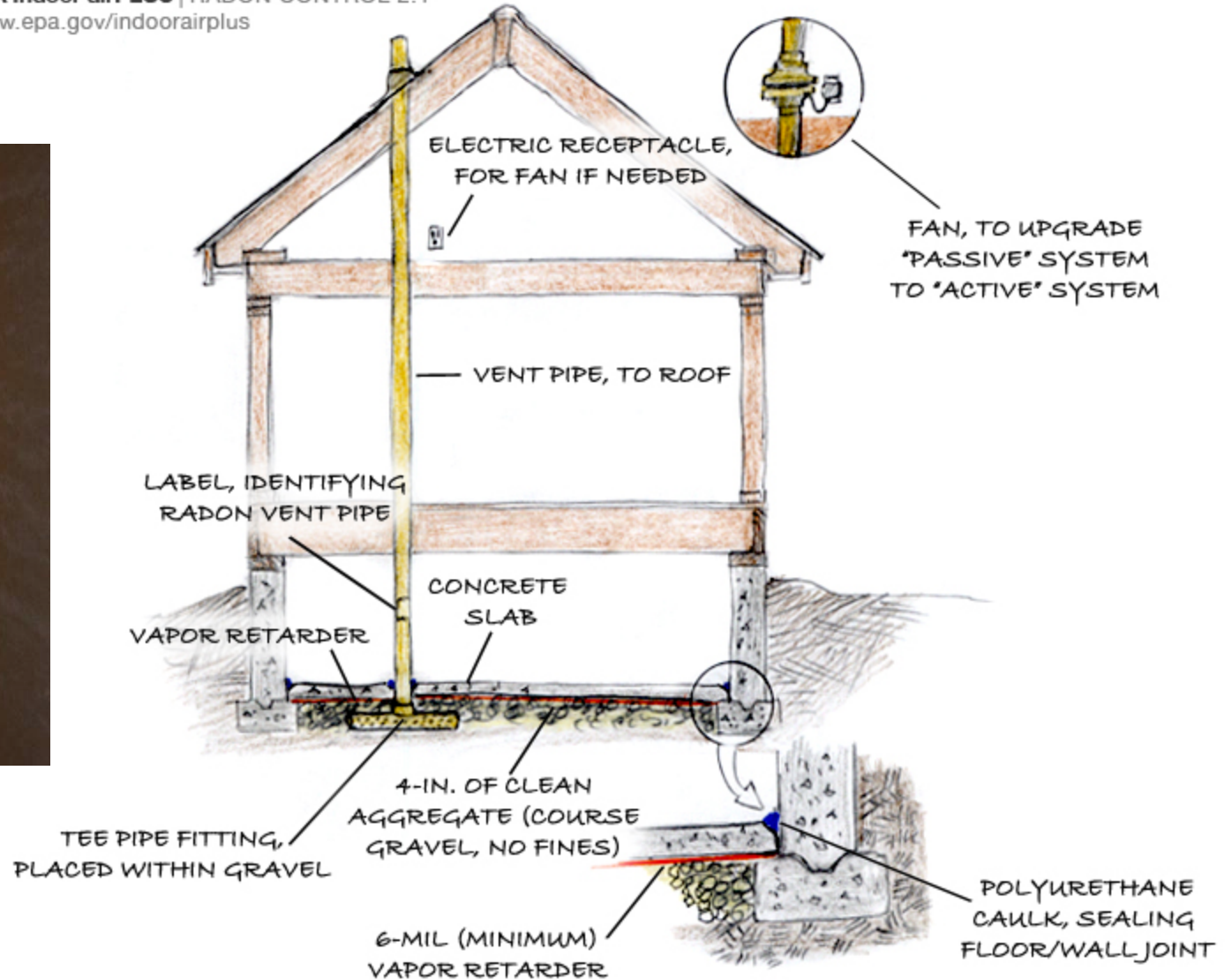
- Construct homes built in EPA Radon Zone 1 with radon-resistant features.
- Advisory:
 - Passive Systems recommended in Zones 2-3.
 - Educate homeowners.

For more on radon-resistant construction, see:
<https://www.epa.gov/radon/radon-resistant-construction-basics-and-techniques>



2.1 Radon Control

EPA Indoor airPLUS | RADON CONTROL 2.1
www.epa.gov/indoorairplus



2.1 Radon Control

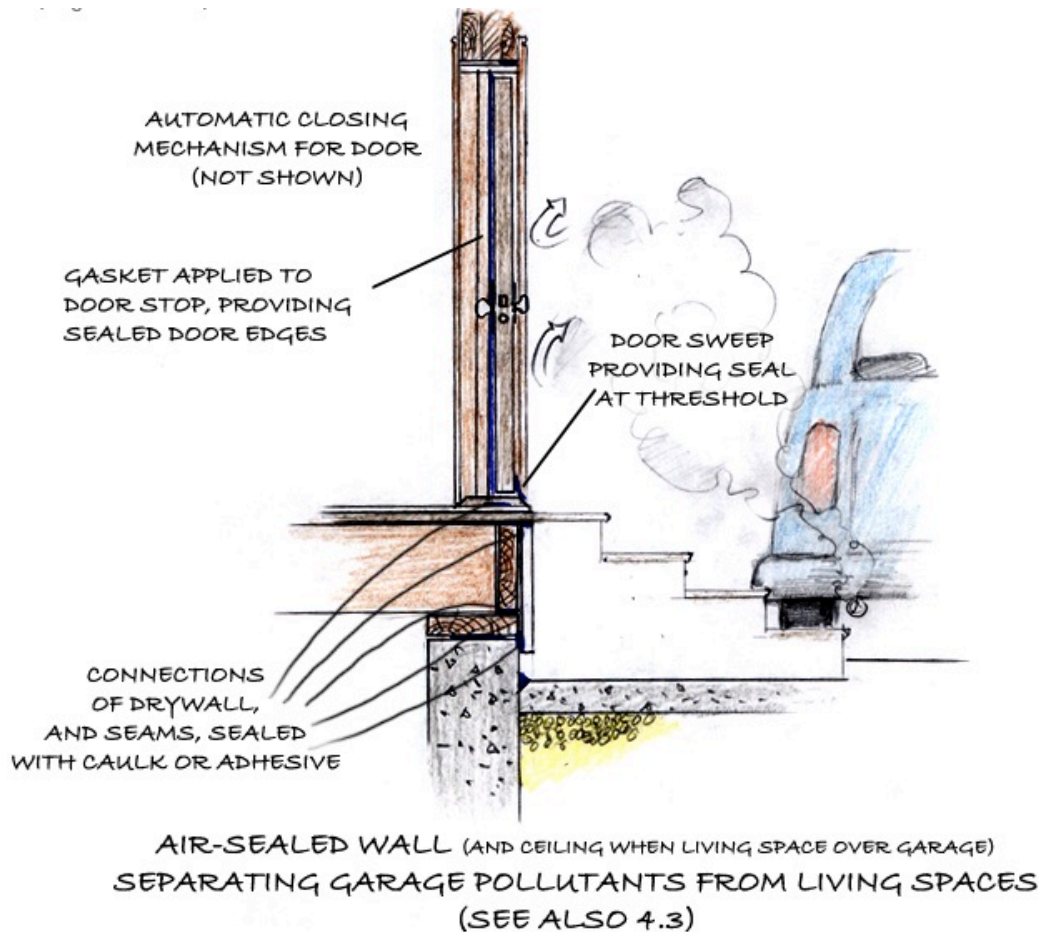
Guidance for homes with vaulted or sealed/conditioned attics:

2 options:

1. Radon fan installed in an approved exterior location (active system)
2. Electrical receptacle installed in an accessible attic or other exterior location near the radon vent pipe



5.4 Attached Garages



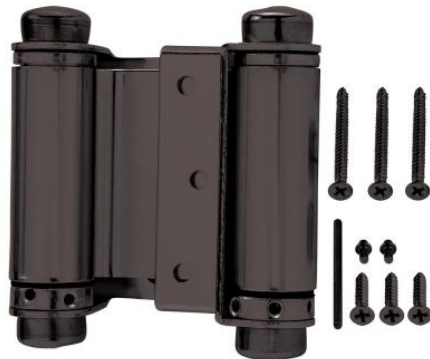
1. **Isolated** from conditioned spaces:
 - Common walls and ceilings are **air-sealed**.
 - No HVAC equipment or ducts in garage.
 - Weather stripping and an automatic door closer is installed on connecting doors between living space and garage.
2. Appropriate ventilation strategy or pressure testing ensures separation from living space.

These requirements apply to all homes, even when the homebuyer is committed to electric vehicle ownership.



Self-closing door mechanisms

- Not expected for overhead door, just door between garage and living space
- Self-closing/spring hinge is sufficient
- Many low cost options available



5.4 Attached Garages



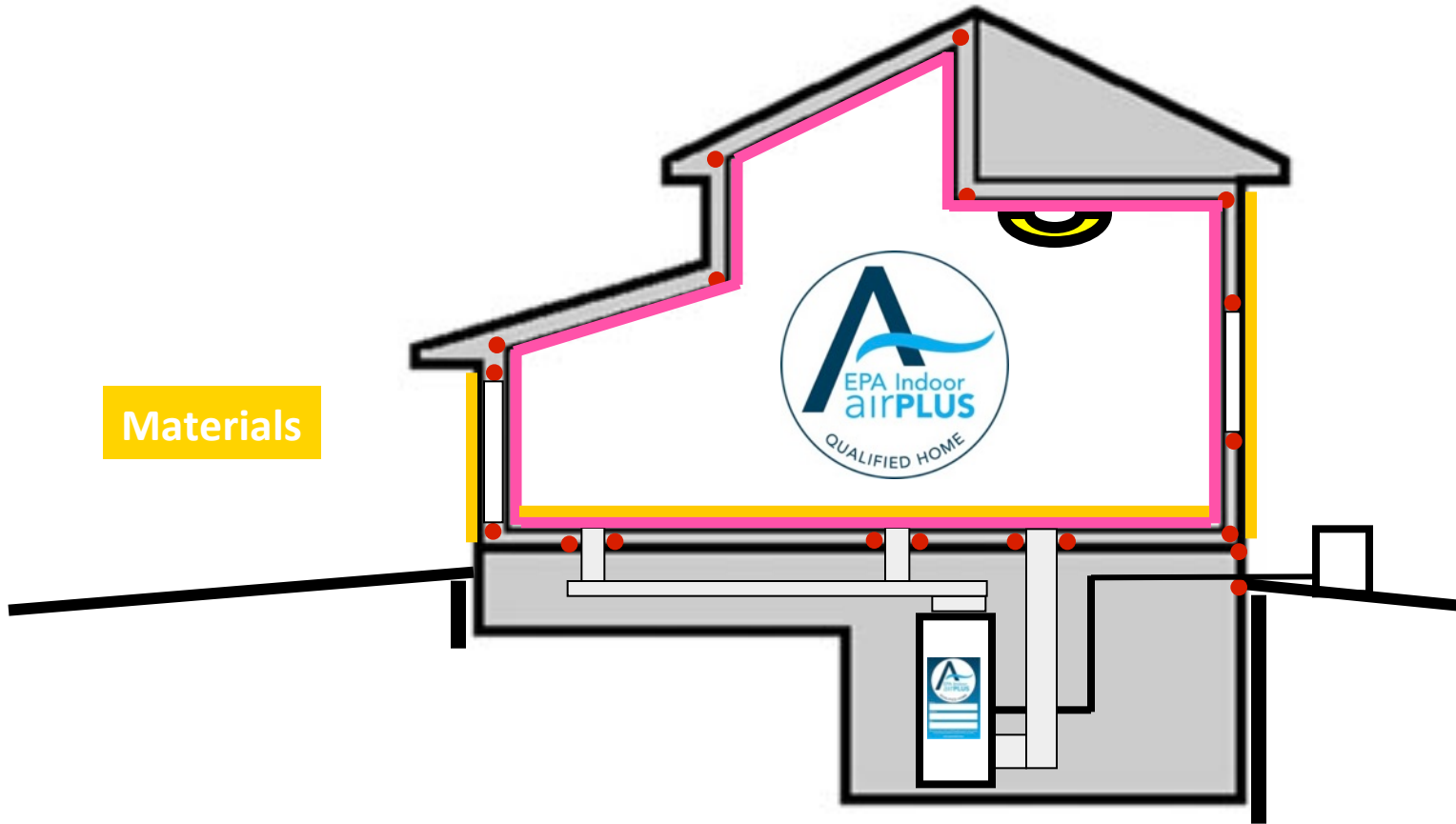
- ✓ *Isolate attached garages from conditioned spaces:*
 - ✓ *Air-seal common walls and ceilings.*
 - ✓ *Use weather stripping on all doors between living spaces and attached garages.*



- Install an automatic door closer on all connecting doors between living spaces and attached garages.
- In homes with exhaust-only whole-house ventilation either:
 - Equip the attached garage with an exhaust fan with a minimum installed capacity of 70 cfm that is vented directly outdoors; OR
 - Conduct a pressure test to verify the effectiveness of the garage-to-house air barrier.



6. Low Emission Materials



6. Low Emission Materials



Potential Issues:

- Indoor levels of many chemical pollutants can be **2-5 times higher than outdoor levels.**
- Volatile Organic Compounds (VOCs) include a variety of chemicals, some of which may have short- and long-term adverse health effects, including eye, nose and throat irritation, headaches, loss of coordination, nausea, damage to liver, kidney, and central nervous system.



What are the Requirements?

6.1 – Composite Wood

Structural panels, cabinetry, shelving, trim, doors, stair treads, flooring, etc.

6.2 - Interior Paints and Finishes

Site-applied coatings only, but not simply “low-VOC”.

Indoor airPLUS – Section 6 *Low-emission Materials*

6.3 – Carpet and Carpet Adhesives

CRI Green Label

6.4 – Adhesives and Sealants

Recommended but not yet required.



How to Find Indoor airPLUS Compliant Low Emission Products

How to Find Indoor airPLUS Compliant Low-Emission Products

The Low-Emission Materials requirements contained in Section 6 of the Indoor airPLUS Construction Specifications address composite wood products, interior paints and finishes, and carpets and carpet adhesives used in the construction of Indoor airPLUS qualified homes. This document is intended to help builders, designers, and Raters identify and locate compliant products.

Basic Information:

1. Your product supplier and/or product manufacturers are likely to be the best source of information about low emission products.
2. Many of the certifications and labels identified below meet multiple and/or overlapping standards. A single listed label or certification for a specific product is sufficient to comply with Indoor airPLUS requirements.
3. The certification marks displayed in the table below are EXAMPLES only. Other certifications that meet the underlying referenced standards may also be compliant with the Indoor airPLUS requirements. In addition, the listed programs and standards may have different or additional labels, and other certification marks may be used by the programs listed below. For more background on these standards and labels, see "Additional Information on Referenced Standards and Programs" on pages 7-10.
4. Use caution in selecting "green" product labels. Other labels may claim to be healthier or more eco-friendly, but they may not comply with the Indoor airPLUS Construction Specifications.

To request that other compliant certifications or programs be added to this resource or for additional questions about these or other Indoor airPLUS Construction Specifications, please contact Indoor_airPLUS@epa.gov. For complete information about Indoor airPLUS, visit the Indoor airPLUS website at www2.epa.gov/indoorairplus.

6.1 Composite Wood

to All composite wood products installed in the home during construction. Examples include panels, cabinetry, shelving, trim, doors, stair treads, flooring, etc.

OSB label:

These products are certified as compliant with PS1 or PS2, as appropriate, and adhesives as indicated by "Exposure 1" or "Exterior" designation (APA-1000).

How to find compliant products

OSB label. These products require a label. List of APA PS1 products.

Labels and Certifications:

- GREENGUARD
- CERTIFIED GREEN SEAL
- GREEN WISE
- GREEN WISE GOLD
- MPI GREEN PERFORMANCE
- MPI EXTREME GREEN

Product Labels:

APA C-0 PLUGGED GROUP 2 LIST OF EXPOSURE 1 THICKNESS 5/8 IN. 000 PS 1 OR PS2 CATEGORY

APA RATED BREATHING 32/16 NEW FOR SPECIES EXPOSURE 1 THICKNESS 5/8 IN. 000 PS 1 OR PS2 CATEGORY

HPVA (70% or more CARB) Primary adhesives containing no added formaldehyde.

FLAME SPREAD CLASS C 200 OR LESS ASTM E84

BOND LINE TYPE I or II ANSI/HPVA HP-1-2009

- Guidance on identifying compliant low-emission products and 3rd party labels.
- <https://www.epa.gov/indoorairplus/indoor-airplus-compliant-low-emission-products>
- RESNET 2016 in-depth presentation: [Plain Speak on How to Find the Right Products](#)



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EPA Indoor airPLUS



The U.S. Environmental Protection Agency (EPA) Indoor airPLUS checklist provides links to technical guides that align with measures included in the EPA Indoor airPLUS program requirements. The numbers and titles included in this checklist follow the same order and numbering as those in the EPA Indoor airPLUS Verification Checklist. At this time, only measures associated with the DOE Zero Energy Ready Home program are displayed in the accordions below. Completing these requirements fulfills the "Indoor Air Quality" section of the DOE Zero Energy Ready Home Program. To view the full program requirements see EPA's [Construction Specifications](#) document. Portions of the programmatic footnotes have been added to the Scope tabs in the guides. For additional DOE Zero Energy Ready Home program requirements and information, visit the [DOE Zero Energy Ready Home Website](#).

[▶ ENERGY STAR for Homes Baseline](#)[▶ Moisture Control](#)[▶ Radon](#)[▶ Pests](#)[▶ HVAC Systems](#)

Technical Resources and Tools

<https://basc.pnnl.gov/checklists/epa-indoor-airplus>



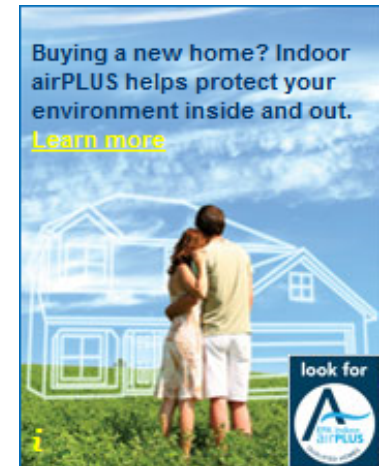
Indoor Air Quality (IAQ)

Resources and Tools

Marketing and Technical Support for Partners



- Builder and consumer resources
- Partner locator
- Website widgets
- Construction requirements
- Technical guidance



www.epa.gov/indoorairplus





Indoor airPLUS



A new opportunity for leading builders to create better environments inside and out

Learn more at:

www.epa.gov/indoorairplus

**OR contact the Indoor
airPLUS Team at**

indoor_airPLUS@epa.gov