



WHY HOME IMPROVEMENT EXPERT?

An easy way to get a quality job.

Research findings reveal significantly reduced energy savings and potential performance risks where home improvements are not properly installed. To help homeowners address this challenge, the U.S. Department of Energy has compiled world-class expert guidance from industry leaders and national laboratories in factsheets and checklists under the name **Home Improvement Expert**. Homeowners can leverage these expert recommendations to help ensure quality installation by attaching Home Improvement Expert checklists to vendor contracts and ensuring the vendor completes and signs the checklist before accepting the work.

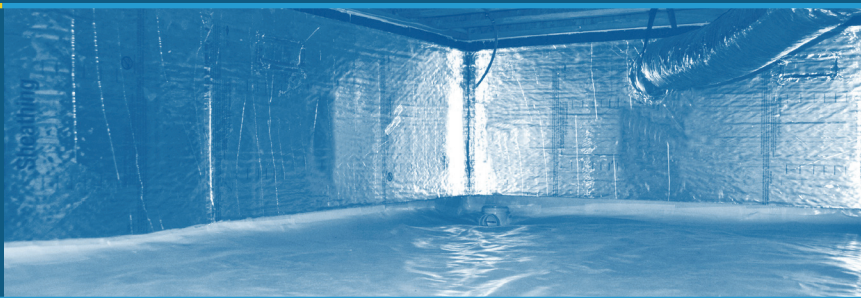
READY TO DO MORE?

This factsheet and accompanying checklist cover one of more than 20 home improvements covered by the U.S. Department of Energy Home Improvement Expert. Use them to help optimize energy savings and improve performance related to comfort, health, safety, and durability.

To download other checklists: basc.pnnl.gov/home-improvement-expert

For more customized home improvement recommendations:

- Get your **Home Energy Score** from a qualified assessor (www.home-energy-score.gov)
- Schedule an expert assessment through **Home Performance with ENERGY STAR®** (www.energystar.gov/homeperformance).



BENEFITS

Converting a crawl space from vented to unvented can reduce utility costs while improving comfort, indoor air quality, and durability.

To convert a vented crawl space to an unvented crawlspace, all of the vent openings are covered and sealed and insulation is installed at the exterior walls instead of at the underside of the floor above. As a result, the crawl space becomes part of the conditioned space of the home. This provides a temperate space for any heating and cooling equipment located in the crawl space so it will last longer and operate more efficiently. Sealing off the vents, insulating the walls, and covering the ground with a vapor barrier that is sealed to the walls also helps to reduce potential moisture problems by keeping humid outside air and moisture vapor and soil gases from the ground out of the crawl space and out of the home. As an added benefit, the conditioned crawl space can provide climate-controlled storage space. In addition, the careful air sealing that goes into an unvented crawlspace may help to block radon and other soil gas entry into the home.

RELATED HOME IMPROVEMENT CONSIDERATIONS

Before converting your crawl space from vented to unvented, consider working with a qualified home energy assessor to evaluate other related home performance needs and opportunities. This includes:

- testing for adequate combustion air for natural draft combustion equipment (e.g., furnace, boiler, or water heater);
- radon testing and mitigation if levels exceed EPA limits;
- integration of fresh air into the HVAC system to provide ventilation;
- installation of kitchen and bath fans to remove moisture, odors, and stove emissions.

For more information on crawls spaces, please search the Building America Solution Center, basc.pnnl.gov.

TIPS FOR HIRING A CONTRACTOR

- Look for licensed, insured, and certified contractors.
- Check references and reviews on home improvement web sites.
- Get multiple bids in writing.
- Check with your utility and state, local, and federal weatherization programs for rebates and incentives.
- Include the Home Improvement Expert™ checklist in bids and contracts to ensure quality installation.
- Consider using a Residential Energy Services Network (RESNET) certified Home Energy Rating System (HERS) rater, Building Performance Institute (BPI) certified Building Analyst, or other qualified professional (e.g., licensed engineer or architect) to inspect the work.

ENCLOSURE UPGRADES

Attic Air Sealing and Insulation

Basement Wall Insulation

Comprehensive Attic Upgrade

Framed Wall Insulation

Masonry Wall Insulation

Home Air Sealing

Vented to Unvented Attic

Vented to Unvented Crawl Space

Window Replacement

HEATING & COOLING

Air Conditioner Replacement

Gas Furnace Replacement

Heat Pump Replacement

Duct Sealing and Insulation

Oil or Gas Boiler Replacement

HOT WATER HEATING

Gas Tank Water Heater

Gas Tankless Water Heater

Heat Pump Water Heater

FRESH AIR SYSTEM

Bathroom Exhaust Fan

Kitchen Exhaust Fan

Balanced HRV/ERV

Balanced Supply plus Exhaust

Supply Integrated with HVAC

PROPER SEQUENCING OF HOME IMPROVEMENTS

Through the U.S. Department of Energy's Building America research program, expert guidance has been developed for optimizing whole-house energy-efficiency upgrades. This includes a recommended sequence for home improvements (shown below) to help ensure homeowners get the most out of their upgrade investments while minimizing potential harm from safety, indoor air quality, and moisture issues.

STEP 1: ENSURE SAFE AND DURABLE

Have experts assess opportunities to improve energy efficiency and identify comfort, moisture management, health, and safety issues.

**STEP 2: ENSURE FRESH AIR**

Ensure effective ventilation before increasing air tightness.

**STEP 3: ENSURE MOISTURE CONTROL**

Ensure adequate water protection before reducing the ability of walls to dry by adding air sealing and insulation.

**STEP 4: ENSURE DRAFT-FREE**

Capture air sealing opportunities not accessible after insulation is installed.

**STEP 5: ENSURE THERMAL COMFORT**

Insulate at least to the latest national code recommendations for your location after addressing related safety, indoor air quality, and moisture management issues.

ANYTIME: EQUIPMENT UPGRADES

Replace heating and cooling equipment, water heaters, windows, appliances, lighting, fans, and electronics when they fail or become out of date with ENERGY STAR® qualified products or better, and improve systems to operate more efficiently.



This U.S. Department of Energy checklist includes important specifications that can contribute to a complete and quality installation. All work shall comply with these specifications, all relevant codes and standards, and all manufacturer installation instructions. The contractor shall check each box on the checklist below and sign and date at the bottom to certify the work is completed.

PREPARATION

<input type="checkbox"/>	The crawl space shall be inspected for any evidence of bulk water penetration, moisture, or pest damage, and a list of any potential problems shall be provided to the homeowner before proceeding with the work so remediation can be fully addressed as necessary.
<input type="checkbox"/>	The contractor shall verify proper foundation drainage and foundation waterproofing/damp-proofing and determine if flood vents are needed before proceeding.
<input type="checkbox"/>	If the crawlspace ground level is below the surrounding grade, perimeter drainage shall be provided.
<input type="checkbox"/>	Sufficient access shall be provided. A minimum 16x24-inch, airtight, insulated access door shall be installed in the perimeter wall. If below grade, a minimum 16x24-inch threshold is also required. Alternatively, a minimum 18x24-inch access panel shall be installed through the floor inside the home.
<input type="checkbox"/>	Any existing insulation shall be removed and any rotting wood shall be replaced. All wall surfaces shall be cleaned of any dirt or debris.
<input type="checkbox"/>	A minimum 6-mil-thick polyethylene sheeting shall be installed over the entire ground with a minimum lap of 6 to 12 inches; all seams and any tears or holes shall be taped. In addition, the polyethylene sheathing shall be extended a minimum of 6 inches up all foundation walls and concrete footings and taped to the walls or footings for a continuous seal. Note: the ground shall be cleared of all vegetation and organic material before installing the ground vapor barrier.

INSTALLATION

<input type="checkbox"/>	All sealants used shall be compatible with their intended surfaces and meet fire rating requirements around flues. Maximum gap dimensions shall be consistent with manufacturer's specifications.
<input type="checkbox"/>	Foundation wall vents and other penetrations shall be blocked and sealed. If required, some vents may be replaced with flood vents that include weather stripping to reduce standby air infiltration.
<input type="checkbox"/>	All penetrations through the framed floor shall be sealed for fire safety in accordance with the International Residential Code. Some jurisdictions may require a non-porous sealing product.
<input type="checkbox"/>	Cripple walls, rim joists, and foundation walls shall be air sealed and insulated to an R-value that meets or exceeds the 2012 International Energy Conservation Code prescriptive requirements for the home's location.
<input type="checkbox"/>	Insulation installation shall meet ignition barrier requirements.
<input type="checkbox"/>	All rim joists adjoining the exterior shall be insulated with high-density closed-cell foam sprayed directly against the rim joist or with rigid foam that is cut to fit and sealed in place with caulk or canned spray foam.
<input type="checkbox"/>	Foundation walls shall be insulated with either spray foam or rigid foam insulation.
<input type="checkbox"/>	If using spray foam, high-density closed-cell or medium-density open-cell foam shall be sprayed directly on the entire surface of all foundation walls adjoining the exterior.
<input type="checkbox"/>	If using rigid foam panels, they shall be attached to the interior of the foundation wall with construction adhesive applied in a serpentine pattern. When using two layers of foam, the seams should be staggered. These panels shall completely cover all crawlspace wall surfaces with no air gap between them and they shall be fully in contact with the masonry wall, with no gaps. Panel seams shall be fully sealed with caulk, foam, mastic, or flashing tape that is specified as acceptable by the rigid foam insulation manufacturer.



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COMMISSIONING

<input type="checkbox"/>	HVAC supply and return air flow to the crawl space shall be provided at a rate of 1 CFM/50 ft ² of crawl space floor area.
<input type="checkbox"/>	Water intrusion shall be monitored after the work is complete and any necessary repairs shall be made.
<input type="checkbox"/>	After completion, a combustion safety test shall be performed if any natural draft combustion equipment (e.g., water heater, furnace) exists in the crawl space to ensure there is no back-drafting or spillage of combustion emissions.
<input type="checkbox"/>	Although not required for a crawl space project, it is recommended that the home should be inspected for the presence of a whole-house ventilation system. If one is present, the actual air flow shall be tested and verified to meet a target ventilation rate based on house size as follows: 50 cfm for up to 1,500 ft ² , 70 cfm for 1,501 to 2,500 ft ² , and 100 cfm for over 1,500 ft ² . If the home has no whole-house ventilation system, or if the existing system does not meet the target ventilation rate, recommendations shall be made to the homeowner to either install a new system or repair the existing system to meet the target ventilation rate.
<input type="checkbox"/>	At the completion of the work, best practice recommendation is for a radon test kit to be acquired by the homeowner with a recommendation to initiate a radon remediation strategy if post-retrofit radon measurements exceed EPA acceptable levels.

I hereby certify that, to the best of my knowledge and ability, all checked items on the above checklist have been accomplished as part of completion of this home upgrade.

Contractor Signature: _____ Date: ____/____/____

Contracting Organization: _____

THE U.S. DEPARTMENT OF ENERGY DOES NOT WARRANT OR ENDORSE THE WORK, PRODUCTS, OR SERVICES OF ANY OF ITS PARTNERS.

