

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

Installed correctly, energy-efficient windows can reduce utility costs while improving comfort and durability.

Old windows represent a substantial source of heat loss in winter and heat gain in summer because they provide 5 to 10 times less thermal protection than an insulated wall. With typical window replacements, the existing frame is left in place to minimize the disruption and cost. However, existing windows were often never air sealed behind the trim at the rough opening around the window frame and the window may also lack pan flashing. Homeowners who are replacing windows must decide whether to address these areas of potential air and water leakage by doing a full-frame window replacement or to minimize costs and leave the existing frame in place.

RELATED HOME IMPROVEMENT CONSIDERATIONS

Before replacing your home's windows, consider working with a qualified home energy assessor to evaluate other related home performance needs and opportunities. This includes:

- Assessing any indications of air or water leakage and considering a full-frame replacement including air sealing and window flashing where problems are identified. This is especially important where there are plans to add insulation to the walls because they will be more vulnerable to moisture damage from leaking windows.
- Consider using a RESNET or BPI certified home energy assessor.
- Consider consulting an architect and local code officials to assist with meeting historic preservation criteria where required.

For more information on windows, 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

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

- An ENERGY STAR certified or better window matched to the climate zone for this specific home shall be selected for all windows to be replaced.
- Egress windows and safety glass shall be specified in accordance with local codes.
- The presence of lead-based paint in pre-1978 homes shall be assumed unless testing confirms otherwise. The work shall comply with EPA's Lead Renovation, Repair and Painting (RRP) Rule (40 CFR Part 745) in pre-1978 homes and proposed changes to this rule (Federal Register/Vol. 75, No. 87/ May 6, 2010).

INSTALLATION: OPTION 1 - WINDOW REPLACEMENT IN EXISTING FRAME

- Interior stops, sashes, parting strips, and pulleys shall be removed and the rough opening shall be cleaned and fully sealed.
- Sealants shall be durable, pest resistant, compatible with their intended surfaces, have a weather-appropriate seal, and be applied in accordance with the manufacturer's specifications.
- Indoor sealants shall be low volatile organic compound (VOC) products that meet independent testing and verification protocols, such as Green Seal, GREENGUARD, or comparable certifications.
- Replacement windows shall be installed in accordance with the manufacturer's specifications, ensuring that the exterior stops are caulked and that the new window inserts are sealed at the existing frame.

INSTALLATION: OPTION 2 - FULL-FRAME WINDOW REPLACEMENT (RECOMMENDED)

- Replacement windows shall be installed in accordance with manufacturer's specifications and with ASTM E2112-07(2016) Standard Practice for Installation of Exterior Windows, Doors and Skylights.
- Exterior cladding or trim shall be removed as required to install exterior head, jamb, and sill flashing. Cladding or trim that is removed shall be replaced after flashing is installed to match existing exterior finishes.
- Trim and finishes shall be removed as required to fully expose the rough opening on all four sides around each window and internal weight pockets used for older windows. If there are internal weight pockets, all hardware shall be removed. The rough opening and/or pockets shall be fully insulated and air sealed with non-expanding spray-in foam or blown-in insulation and sealants.
- Head, jamb, and sill flashing shall be fully integrated with the weather-resistant barrier (e.g., house wrap, building paper, taped water-resistant sheathing, liquid-applied coating, or another approved material). Membranes shall be installed shingle-fashion where the top layer of the flashing or weather-resistant barrier laps over the bottom layer to prevent water from draining behind the bottom layer.
- Add material or cut the existing weather-resistant barrier to create a flap at the top of the window opening. Tape the flap so that it is temporarily folded up, toward the sky.
- Extend the weather-resistant barrier 4 inches into the frame opening and wrap around the opening toward the interior of the house. Trim the weather-resistant barrier if needed to ensure it will not be visible from the interior of the house after trim is installed.
- Rigid, flexible, or fluid-applied pan flashing shall be installed at sills and extend to the face of the weather-resistant barrier.
- Caulk the outside edges of the head and side jambs. Do not caulk the across the sill.
- Windows shall be installed according to the manufacturer's instructions including installing flanges over the flashed opening, or with metal clips provided by the window manufacturer for this purpose, or with 20-gauge metal tie plates screwed to the window first if metal clips are not provided.



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INSTALLATION: OPTION 2 - FULL-FRAME WINDOW REPLACEMENT (RECOMMENDED) CONTINUED

<input type="checkbox"/>	Side (jamb) flashing shall be installed over window flanges and pan flashing and extend above the top (head) flange and shall be integrated with the weather-resistant barrier on the exterior sheathing.
<input type="checkbox"/>	Top (head) flashing shall be installed over and beyond the jamb flashing (and over the drip cap if installed) and shall be fully integrated with the weather-resistant barrier on the exterior sheathing. Install the top flashing so that it does not inhibit the flap created in the weather-resistant barrier from being folded down.
<input type="checkbox"/>	Flashing shall be integrated with the weather-resistant barrier at the top of the window (e.g., fold down and tape the house wrap over the head flashing).
<input type="checkbox"/>	All cladding or trim removed to install flashing shall be replaced with either wood, cementitious board, or composite exterior trim to match existing and shall be primed on all six sides.
<input type="checkbox"/>	All interior trim and finishes removed shall be replaced as required to match the existing trim.

COMMISSIONING

<input type="checkbox"/>	Occupants shall be notified of changes or repairs made and shall be educated on how to operate and maintain the windows.
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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: _____

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