

## Insulation and Thermal Envelope: A Quick Guide for Homeowners

A **home performance upgrade** makes your home more comfortable while helping reduce your energy bills. An upgrade prevents air and energy leaks and ensures that heating and cooling equipment is efficient, that ducts are free of leaks, and that your water heater and other home appliances are working efficiently. Installing quality **insulation** to promote a high-performing **thermal envelope** helps achieve energy savings and comfort.

This quick guide explains the basics of envelope insulation and why it is important. Much of the information in this guide is adapted from *Insulation: A Guide for Contractors to Share with Homeowners*, published by the U.S. Department of Energy.

### THE THERMAL ENVELOPE

#### What is the thermal envelope?

The thermal envelope is the boundaries of the home that separate living space (conditioned) from non-living space (unconditioned). The thermal envelope typically consists of the floor (either the foundation slab, or raised floor above the crawlspace or basement), the walls (including windows and doors), and the attic floor. High performing homes must have a consistent, well-insulated thermal envelope.

To create a high-performing thermal envelope, home performance contractors will evaluate the tightness of your home through air sealing testing. For more information about air sealing, refer to *Air Sealing and Mechanical Ventilation: A Quick Guide for Homeowners*.

#### Insulation and air sealing

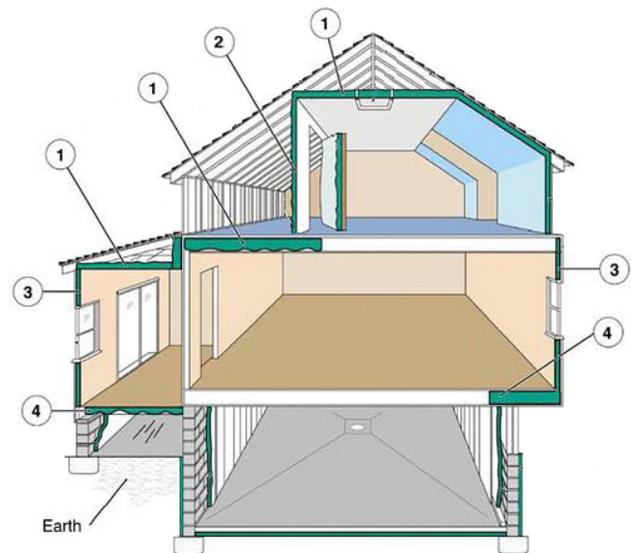
Insulation works with air sealing measures to ensure the thermal envelope performs as intended, keeping your home comfortable through the hottest summer days and the coldest winter nights. Without air sealing, the energy and comfort value of insulation is undermined when warm or cool air penetrates the thermal envelope.

### INSULATION

#### What are the benefits of insulation?

The main benefits of insulation include:

- improved home comfort and air quality due to reduced heat loss during the winter and heat gain during the summer
- lower utility bills due to reduced demand on heating and cooling equipment
- lower carbon footprint



The home's thermal envelope and key places for insulation are shown in green. (source: adapted from U.S. Department of Energy, 2012)

#### Where in the home should insulation be upgraded?

The home should be insulated anywhere conditioned and unconditioned spaces meet. The figure above identifies key locations in the home for adding or upgrading insulation, including:

- (1) attic floors,
- (2) attic walls (such as knee walls),
- (3) exterior walls, and
- (4) floors above unconditioned spaces

#### How is insulation rated?

Insulation material is rated in R-value, or thermal resistance. Three main factors affect an insulation installation's effective R-value:

- insulation thickness,
- material's thermal conductivity (its ability to resist heat transfer), and
- installation quality



Clockwise from top left: fiberglass (batt), fiberglass (blown-in), cellulose (dense-fill), cellulose (loose-fill), foam (blown-in), rockwool

**High-quality installation is key in ensuring insulation is doing its job.** Gaps in the material or between the insulation and the framing material, uneven application, or compression of the material can reduce the effectiveness of the insulation by up to 75%, which wastes energy and money.

**My attic already has some insulation. Can this material be re-used in my insulation upgrade?**

Existing material that is free of dirt, debris, and rodent material may be re-used in your insulation upgrade. To maximize energy savings and indoor air quality, insulation that contains dirt or animal droppings or is compressed should be completely removed before adding new insulation.

**What type of insulation should my contractor install?**

It depends on where the insulation is being installed, your budget, and the individual conditions of your home. There are over a dozen common varieties of insulation, but the materials your SMUD Home Performance Program contractor are most likely to use include:

**Fiberglass.** Composed of a weave of fine glass fibers, about 30% recycled materials. Installed as blanket, batt, or blown-in spray. Batts and spray used in attic floors, knee walls, open walls, crawlspaces. Blow-in fiberglass used in closed walls. Low cost. Requires air sealing to reduce air movement.

**Cellulose.** Composed of chemically treated recycled newsprint. Installed as loose-fill or dense-fill blown-in spray. Used in attic floors, open walls, closed walls. Low cost. Requires air sealing to reduce air movement.

**Rockwool.** Composed of slag or rock spun into fibers. Installed as batt or blown-in spray. Used in attic floors, open walls, walls with siding removed. Medium cost. Requires air sealing to reduce air movement.

**Foam.** Usually composed of petroleum-based synthetic material. Installed in rigid blocks or blown-in spray. Rigid foam used in vaulted ceilings, crawlspace walls, slab perimeters. Blow-in foam used in attic perimeters, vaulted ceilings, open walls, walls with siding removed. High cost. Blow-in foam creates good air barrier. Good in humid climates.

**THE SMUD HOME PERFORMANCE PROGRAM**

**How do I choose a qualified contractor?**

SMUD provides a list of Home Performance Program contractors at [hpp.smud.org](http://hpp.smud.org). All contractors on this list are qualified to earn energy upgrade rebates for your home.

**What rebates available for air sealing and mechanical ventilation?**

**Attic insulation.** Up to \$4000, based on the upgraded insulation area, the existing insulation level, whether existing insulation is re-used, and whether the attic floor is air sealed. Post-upgrade insulation must be at least R-38 (at least R-19 for knee walls).

**Wall insulation.** Up to \$2000, based on the upgraded insulation area. Pre-upgrade walls must not be insulated. Post-upgrade insulation must be at least R-13.

**Crawlspace insulation.** \$1000. Pre-upgrade crawlspace must not be insulated. Post-upgrade insulation must be at least R-19 with a 6 MIL plastic vapor barrier, placed on dirt under home to reduce humidity transfer.

**FOR MORE INFORMATION**

For more information about energy efficiency incentives available through SMUD, visit:

<http://hpp.smud.org/>  
[james.mills@smud.org](mailto:james.mills@smud.org)

For more information about insulation ventilation:

<http://www.eere.energy.gov/>  
<http://www.energystar.gov/>

**Contractors:**  
**Staple your business card here**