

U.S. Department of Energy - Energy Efficiency and Renewable Energy
A Consumer's Guide to Energy Efficiency and Renewable Energy

How Insulation Works

You need insulation in your home to provide resistance to heat flow. The more heat flow resistance your insulation provides, the lower your heating and cooling costs.

Heat flows naturally from a warmer to a cooler space. In the winter, this heat flow moves directly from all heated living spaces to adjacent unheated attics, garages, basements, and even to the outdoors. Heat flow can also move indirectly through interior ceilings, walls, and floors—wherever there is a difference in temperature. During the cooling season, heat flows from the outdoors to the interior of a house.

To maintain comfort, the heat lost in the winter must be replaced by your heating system and the heat gained in the summer must be removed by your cooling system. Properly insulating your home will decrease this heat flow by providing an effective resistance to the flow of heat.

An insulation's resistance to heat flow is measured or rated in terms of its thermal resistance or R-value.

The R-Value of Insulation

An *R-value* indicates an insulation's resistance to heat flow. The higher the R-value, the greater the insulating effectiveness.

The R-value depends on the type of insulation and includes its material, thickness, and density. When calculating the R-value of a multilayered installation, add the R-values of the individual layers. Installing more insulation in your home increases the R-value and the resistance to heat flow.

The effectiveness of an insulation's resistance to heat flow also depends on how and where the insulation is installed. For example, insulation that is compressed will not provide its full rated R-value. The overall R-value of a wall or ceiling will be somewhat different from the R-value of the insulation itself because some heat flows around the insulation through the studs and joists. Therefore, it's important to properly install your insulation to achieve the maximum R-value.

The amount of insulation or R-value you'll need depends on your climate, type of heating and cooling system, and the section of the house you plan to insulate.