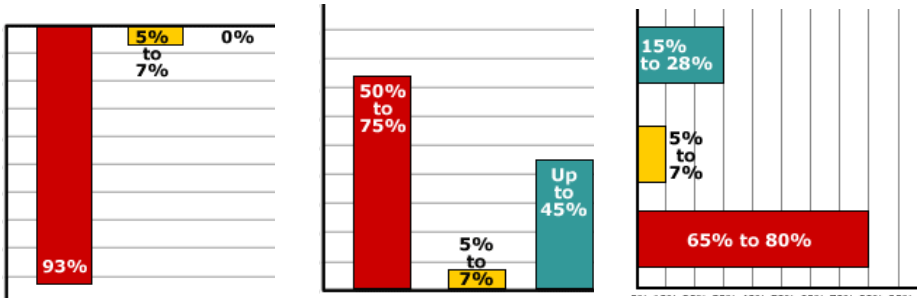
# Heat Gain, Transmission and Loss in Homes

- Infrared light (radiant energy) strikes exterior surfaces of roofs and walls.
- Most incident infrared light is adsorbed (converted to hotter roofs and walls)
- Heat (vibrating molecules) spreads by conduction (molecules exciting adjacent molecules).
- Heat (vibrating molecules) spreads by convection (molecules moving in air).
- Heat (vibrating molecules) produce infrared light which spreads by radiation.
- Warmed exterior surfaces radiate infrared light (radiant energy) to the outdoors.

Radiation is electromagnetic energy traversing space at the speed of light, without mass, without temperature.
Example: infrared, visible and ultraviolet light radiating from the sum and traveling through the vacuum of space.

Conduction is heat passing through a body via vibrating molecules exciting their neighbors.
Example: a poker handle becoming hot after the tip is placed in coals.

Convection is heat spreading via warmer molecules moving to other locations within a gas or liquid.
Convection, if mechanically induced, as by a fan, is "forced" convection.
Heat flow due to "free convection" is largely upward, somewhat sideways, not downward.
Example: heated air molecules next to a warm stove rising.




**gain through roof** **loss through roof** **loss through exterior walls**

**Radiation is the major path of heat gain and loss in homes.**

All materials of any temperature - the sun, stoves, radiators, humans, animals, furniture, ceilings, walls, floors, even icebergs radiate invisible infrared light "rays" or "waves" from their surfaces along straight lines, in all directions, at the speed of light. If they strike another object, they are either absorbed or reflected. Absorbed infrared energy increases the heat contained in a body and its temperature. Heat spreads throughout the body by conduction to its outer surfaces, which, if exposed to air spaces, radiate infrared energy in all directions.

Most construction materials - brick, stone, asphalt, concrete, wood, paper - regardless of color, absorb about 90% and reflect about 10% of the infrared radiation striking their surfaces. Infrared reflectivity can be quite different from reflection of visible light. For example, a glass mirror is an excellent reflector of visible light but a very poor reflector of infrared light. In fact, glass mirrors have about the same reflectivity for infrared light as a heavy coating of black paint! By contrast, an aluminum surface adsorbs only 3% and reflects 97% of the infrared light striking it.

Try this. Hold a piece of aluminum foil close to your face, without touching it to your face. Soon you feel the warmth of your face. Aluminum is an excellent infrared reflector and your skin is and excellent infrared receiver.

Aluminum foil in air practically eliminate energy transfer by radiation and convection - a fact employed regularly by the NASA space program. "Moon suits" are made of reflective foil surfaces surrounding trapped air.

Conventional insulation is useful in slowing heat transfer by conduction and convection. But, we have a splendid opportunity to save air conditioning and heating dollars by using inexpensive aluminum as infrared light reflectors which reject:

- inbound infrared light so it does not become heat gain,
- outbound infrared light so it does not become heat loss.