Weatherization Assistance Program

Weatherization Fundamentals

WEATHERIZATION INSTALLER/TECHNICIAN FUNDAMENTALS

Introduction to Weatherization

Mission of the Weatherization Assistance Program

To reduce energy costs for low-income families, particularly for the elderly, people with disabilities, and families with children, while ensuring their health and safety (H&S).

Characteristics of Low-Income Households

- Over 90% of low-income households have annual incomes less than $15,000.
- More than 13% of these low-income households have annual incomes less than $2,000.
- According to DOE's Energy Information Administration (EIA), low-income households spend 14.4% of their annual income on energy, while other households only spend 3.3%.
- The average energy expenditure in low-income households is $1,800 annually.
- The elderly occupy 34% of low-income homes.

History

1976 to Early 1980s (First Generation)

- Started in Maine as “Winterization”
- Administered by the Community Services Administration
- Later managed by the Federal Energy Administration
- Volunteer labor
- Low-cost measures
- Little or no accountability

Early 1980s to Late 1980s (Second Generation)

- Used volunteer labor from the Comprehensive Employment & Training Act under the Department of Labor.
- Often installed temporary measures.
- Little or no diagnostic technology.
- Project Retro-Tech – A paper energy audit allowed entry of the areas and R-values in the home to do very basic heat transfer calculations.
- Addressed the building envelope.
- WAP's "Blow and Go" – Program for attics. Completed houses quickly, but with much less improvement than is common today.

History

1990s (Third Generation)

- Used paid professional labor.
- Addressed both building envelope and mechanical heating systems.
- Diagnostic tools used in some states.
- Various components of program computerized.
- State and national evaluations conducted.
- Structured training and technical assistance provided.

1990s to Present (Fourth Generation)

- Weatherization measures are permanent and cost effective.
- States have rental plans to ensure that weatherization benefits, i.e., savings on utility bills, accrue to tenants, not landlords.
- States have health and safety plans that establish protocols for energy-related health and safety measures, like relining chimneys or replacing faulty furnaces.
- There is increased use of advanced diagnostic tools and energy audits.
- Several states leverage funds from other Federal programs and often through utilities to expand the reach of their WAP.
- Through coordination with the U.S. Department of Housing and Urban Development's (HUD) housing agencies, comprehensive rehabilitation and weatherization are possible.

“Old School” Weatherization Measures

Many weatherization programs without strong management, turned into “doors and windows” programs that often included:

- Replacing windows.
- Adding storm windows.
- Replacing doors.
- Adding weather stripping.
- Adding some attic insulation.
- Caulking (by the case).

Doors and windows especially are highly visible and get much publicity, but typically they aren’t cost-effective. The measures that save the most energy – air sealing and adding insulation – are largely invisible.

Modern Weatherization Measures

- Blower door-directed air sealing
- Attic insulation
- Dense-pack sidewall insulation
- Heating and cooling equipment repair and replacement
- Duct sealing and modification
- Electric base load measures
  - LED light bulbs
  - Refrigerator replacement
  - Water heater modification and replacement

Results

- Over 6.4 million homes have been weatherized to date with Federal and leveraged funds such as State and utility monies and fuel assistance program funds.
- The average reduction in energy used for space heating is 35%.
- Favorable benefit-cost ratio of 1.4:1.
- Supports tens of thousands of direct and indirect jobs nationwide; 52 direct jobs for every million dollars invested.

Cost-Effectiveness Requirements

- An SIR of 1 or higher means the savings earned over the lifetime of a given measure are greater than the full cost of installing that measure.
- The SIR of each individual measure must be greater than or equal to 1.
- Energy-related health and safety work is not included in the SIR.
  - There is no federally mandated upper limit for Health and Safety (H&S) funds. Each state designates this in its state weatherization plan.
  - Historically, states have set their upper limit around 10-15%. With an increase in the amount of lead-safe weatherization (LSW) and furnace replacements, that number has increased.
- Requests for higher H&S budgets can encourage increased scrutiny of the state plan.

Cost-Effectiveness Requirements *(Cont.)*

- SIR ≥ 1 means energy cost savings over the lifetime of the measure(s), discounted to present value, equal or exceed the cost of materials, installation, and on-site supervisory personnel.
  - For example, cost-effectiveness of a refrigerator replacement measures the present value of the energy savings over the lifetime of the appliance against the cost to purchase and install a new unit, as well as remove and decommission the old unit.
  - Present value accounts for the time value of money: $10 was worth more 15 years ago than it is today, and $10 spent today is probably worth more than $10 saved 15 years from now.
- States may include overhead costs in their cost-effectiveness requirements, but this limits the weatherization measures that can be done to the house cost effectively.

WEATHERIZATION INSTALLER/TECHNICAN FUNDAMENTALS

Safe Work Practices

OSHA Standards

Occupational Safety and Health Administration (OSHA) Standards

- Ladder safety
- Fall protection
- Personal protection equipment (PPE)
- Respiratory protection
- Motor vehicles
- Power-operated hand tools
- Fire prevention
- Permit-required confined spaces
- Other worker-related OSHA standards

Field Worker Requirements

Field workers must be OSHA-10 certified and must demonstrate the ability to:

- Select, fit, and use the appropriate PPE for a particular task.
- Safely use basic hand and power tools.
- Use a basic first aid kit to treat common job-site injuries.
- Work lead safe.
- Identify serious mold conditions.
- Assess work area safety hazards.

Field Worker Requirements

Field workers must possess a working knowledge of:

- U.S. Department of Energy (DOE) Weatherization Assistance Program regulations and policy.
- Environmental Protection Agency (EPA) guidelines for asbestos, lead, mold, and other health hazards.
- Safety data sheets (SDS).

Field Worker Requirements

Have fun, but be safe!

Protective Gear in Attics

SAFE WORK PRACTICES

Photos courtesy of the US Department of Energy

- Protective suit
- Respirator
- Gloves
- Eye protection
- Ear protection

How Much Mold Is OK?

Photos courtesy of the US Department of Energy

Unsafe Repair

Ground Fault Circuit Interruption

This could save your life.

Summary

- OSHA regulations are designed to keep workers safe.
- Following EPA guidelines when dealing with hazardous materials protects the health of clients, installers, and their families.
- Keep the SDS for commonly used materials on hand so emergency workers can react quickly and effectively in the case of an accident.
- Wear appropriate safety equipment to reduce risk of injury.
- Provide, maintain, and use personal protective gear.
- Know and follow safety regulations.

WEATHERIZATION INSTALLER/TECHNICAN FUNDAMENTALS

House as a System

House as a System

A house is a system of interdependent parts.

- The operation of one part affects many others.
- When they all work together, the house is comfortable, safe, efficient, and durable.

A house will experience problems when its house parts don’t work together properly.

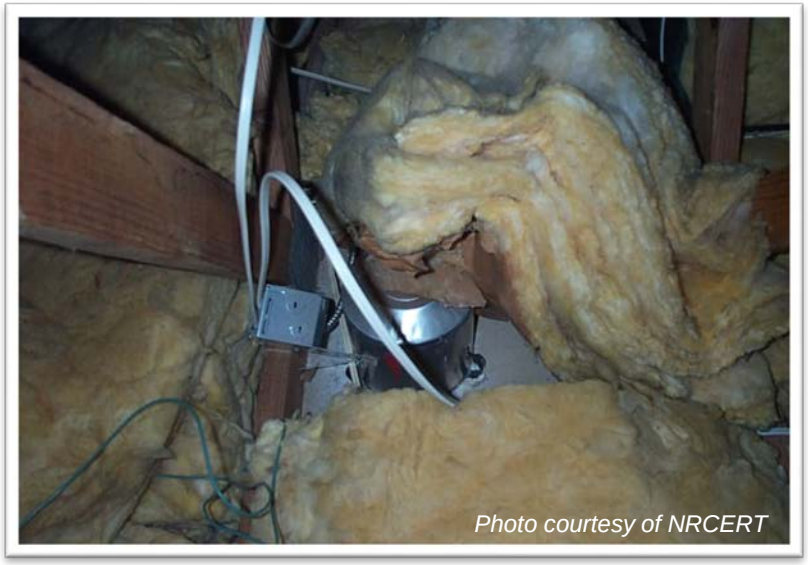
- Some obvious, some invisible.
- Some now, some years later.

Examples

An uninsulated attic ...

Makes the heating and cooling system work harder than necessary.

Examples



Leaky recessed lighting fixtures...

increases heat loss/gain, and can cause ice dams and moisture problems.

Summary

- Every house is a system of interdependent parts, including mechanical and physical components.
- Building failures are symptoms of larger issues.
- Weatherization changes some components, but affects the entire house as a system.

WEATHERIZATION INSTALLER/TECHNICAN FUNDAMENTALS

Building Science Basics

Comfort, Safety, and Efficiency

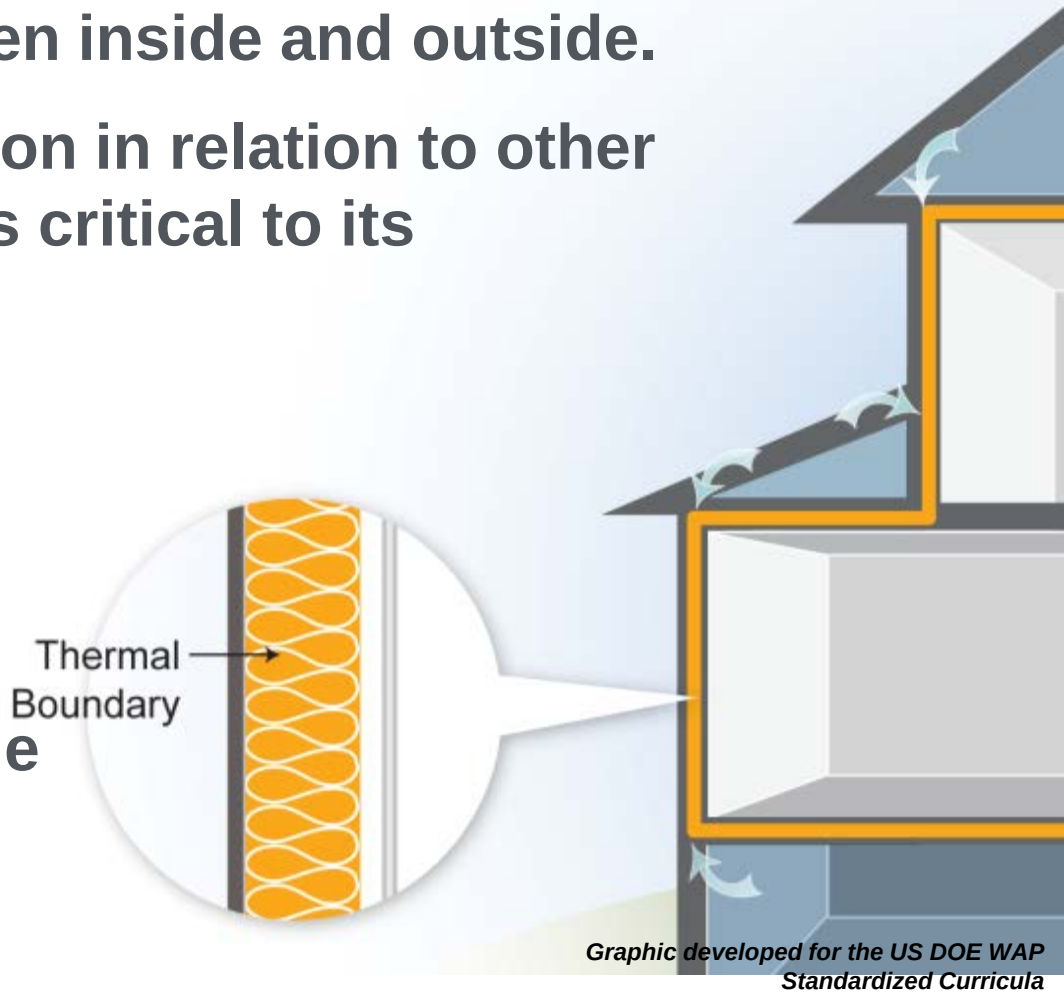
A comfortable, safe, and energy-efficient home requires:

- A fully insulated thermal envelope.
- A well-sealed air barrier.
- The thermal and air boundaries to be continuous and in contact with one another.
- Efficient, properly sized equipment to condition the living space and heat water.
- A well-designed and balanced distribution system.
- Healthy indoor air quality.

Thermal Boundary

The Thermal Boundary:

- Limits heat flow between inside and outside.
- The location of insulation in relation to other building components is critical to its effectiveness.
- Even small areas of missing insulation are very important.
- Voids of 7% can reduce effective R-value by almost 50%.

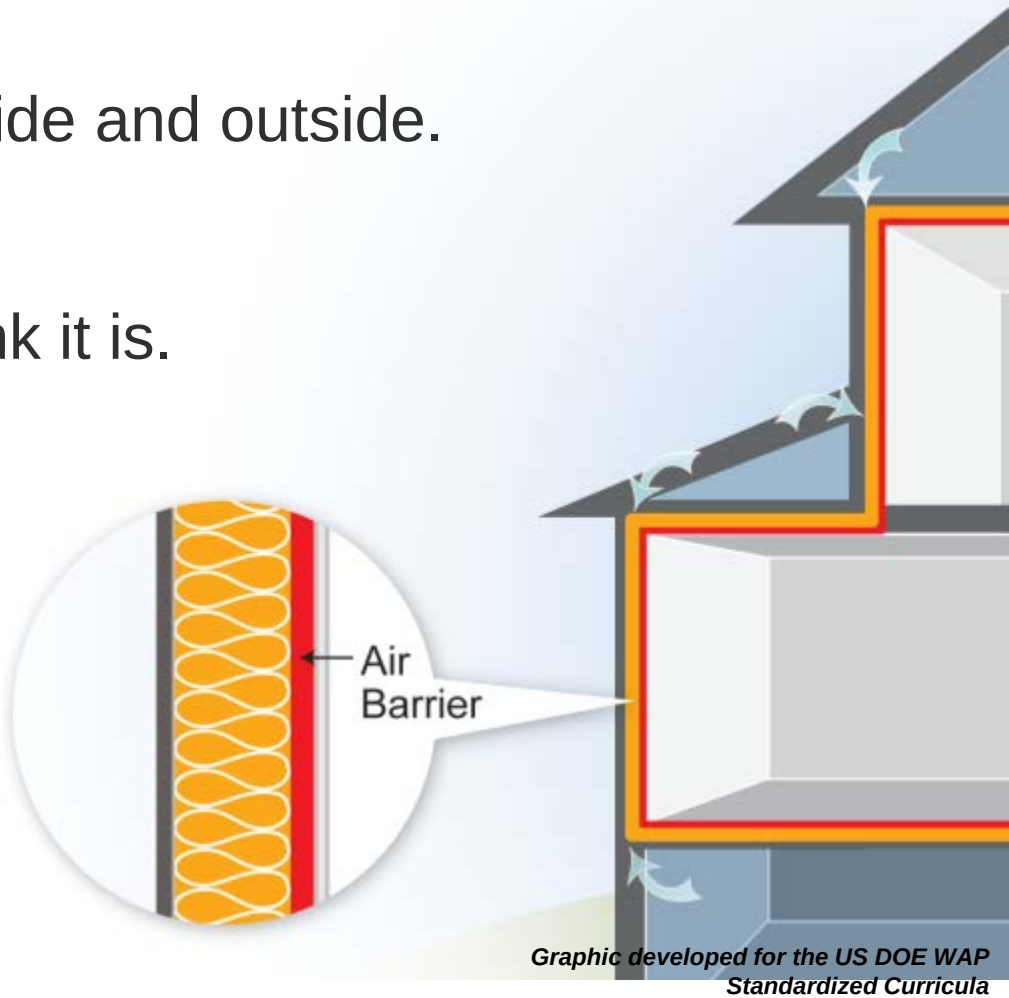


Graphic developed for the US DOE WAP Standardized Curricula

Air Barrier

The Air Barrier:

- Limits airflow between inside and outside.
- More difficult to identify.
- Not always where you think it is.
- Blower door is used to locate air barrier.

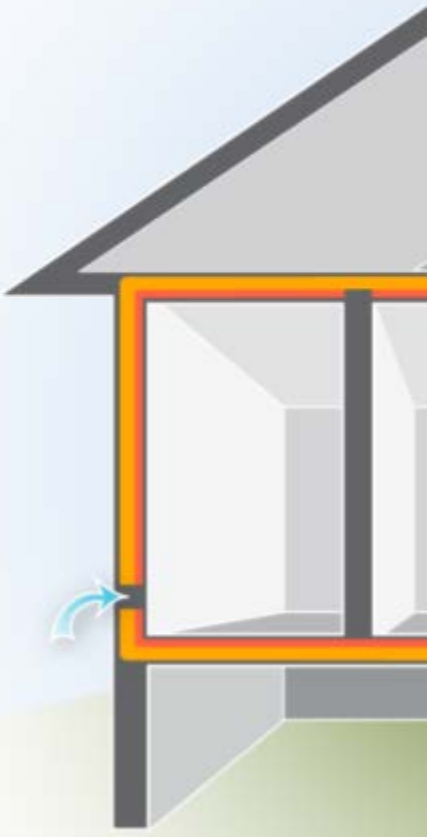


Graphic developed for the US DOE WAP Standardized Curricula

Air Leakage

Air Leakage requires:

- A hole.
- Pressure difference across that hole.
  - The bigger the hole or higher the pressure difference, the more airflow.
  - To reduce airflow, we can reduce the size of the hole or lower the pressure difference.



Graphic developed for the US DOE WAP Standardized Curricula

Air Leakage

- Airflow is measured in cubic feet per minute, also written as ft^3/min, or CFM.
- 1 CFM **OUT** = 1 CFM **IN.**
- Airflow takes the path of least resistance.
- Air moves from **high-** to **low-pressure** areas.
- Air usually moves from **high-** to **low-temperature** areas.

Air Leakage

Direct Leakage

occurs at direct openings to the outdoors. Leakage enters or exits the building envelope directly at this location.

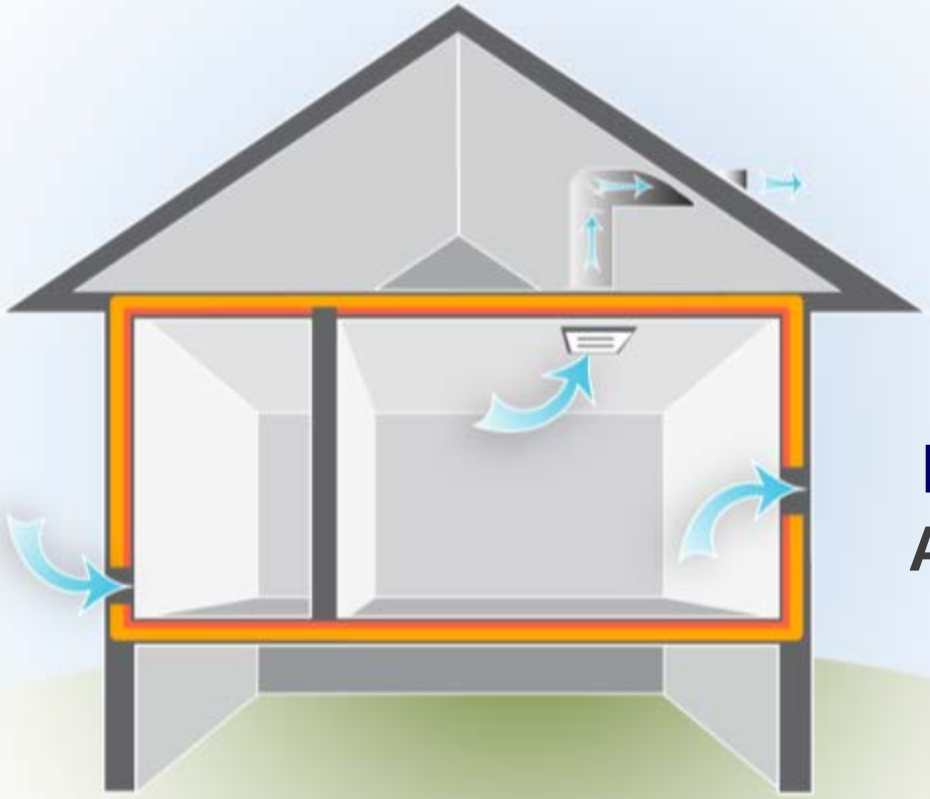
Indirect Leakage

Leakage enters at one location, moves through building cavities, and exits at a different location.

Graphic developed for the US DOE WAP Standardized Curricula

Air Leakage

Ventilation = Controlled air leakage



Infiltration =
Air leaking in

Exfiltration =
Air leaking out

Graphic developed for the US DOE WAP Standardized Curricula

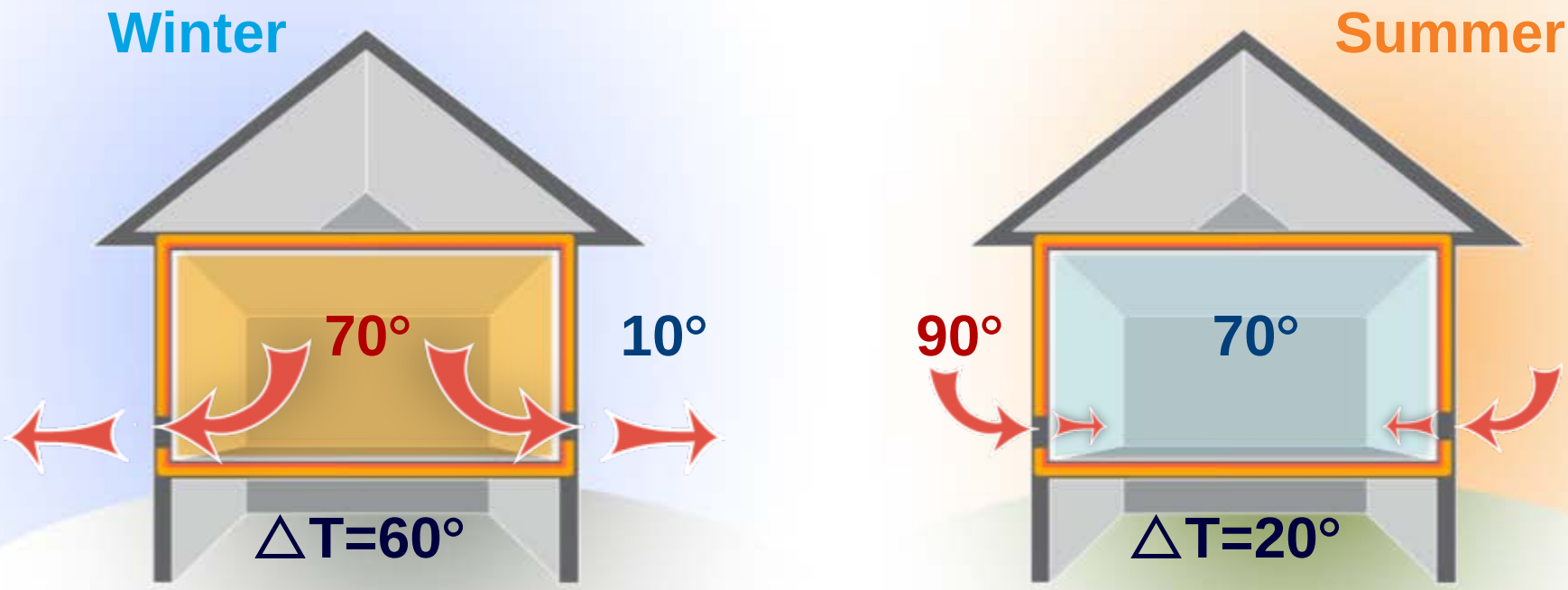
Driving Forces of Air Leakage

Temperature and pressure differences – usually between inside and outside of house

The bigger the temperature or pressure difference, the greater the air and heat flow

Air Leakage: Temperature

△T = Temperature Difference



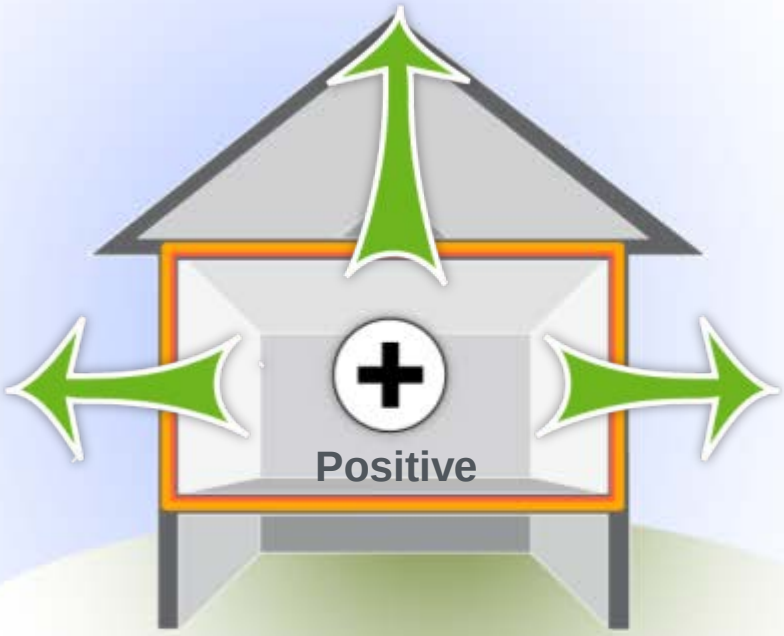
Flow is from hot to cold

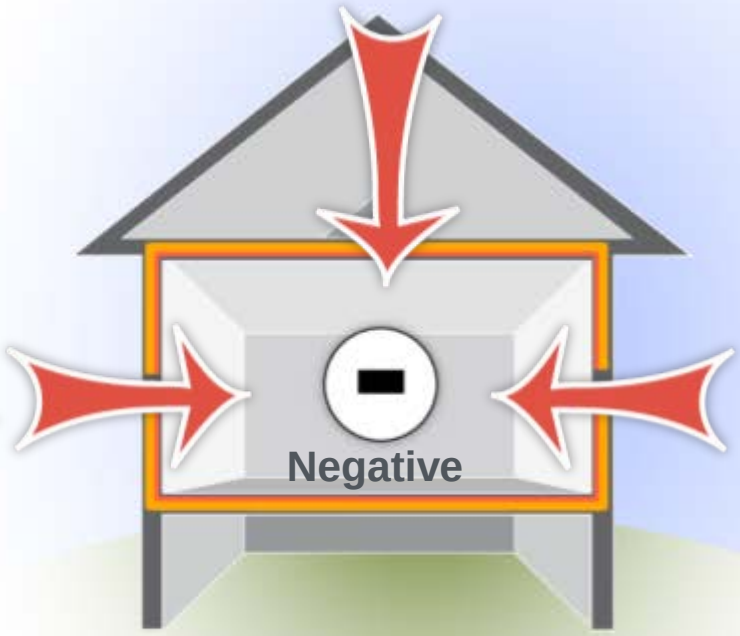
The higher the △T, the more heat and air want to escape or enter the building

Graphic developed for the US DOE WAP Standardized Curricula

Air Leakage: Pressure

△P = Pressure Difference





Flow is from positive (high) to negative (low) pressure

For every CFM that enters, one CFM exits

Flow takes the path of least resistance

Graphic developed for the US DOE WAP Standardized Curricula

Air Leakage: Driving Forces

Types of Driving Forces

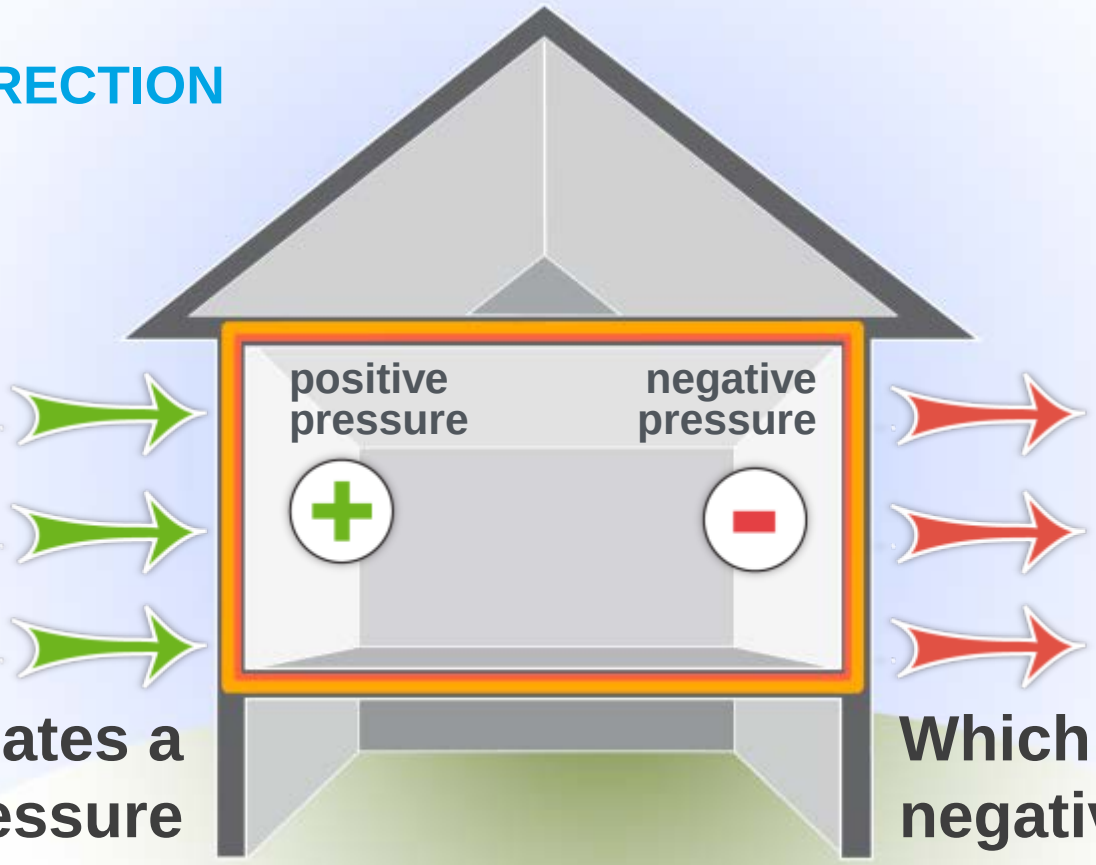
Wind

Heat – Stack effect, combustion

Fans – Exhaust fans, duct leaks, interior doors

Driving Forces: Wind Effect

WIND DIRECTION



Wind creates a positive pressure on the windward side of the building

Which creates a negative pressure on the other sides of the house

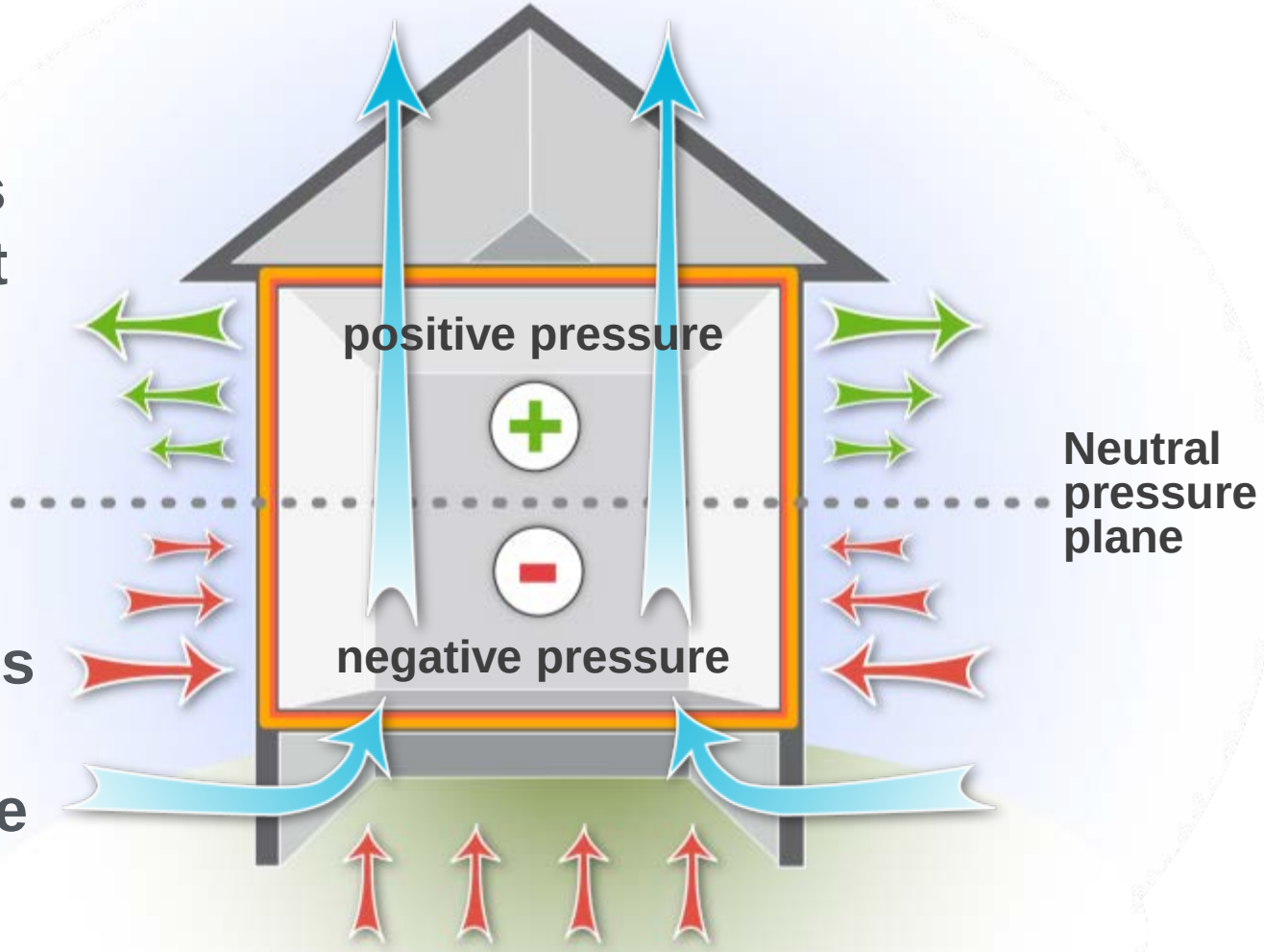
Graphic developed for the US DOE WAP Standardized Curricula

Driving Forces: Stack Effect

Stack Effect

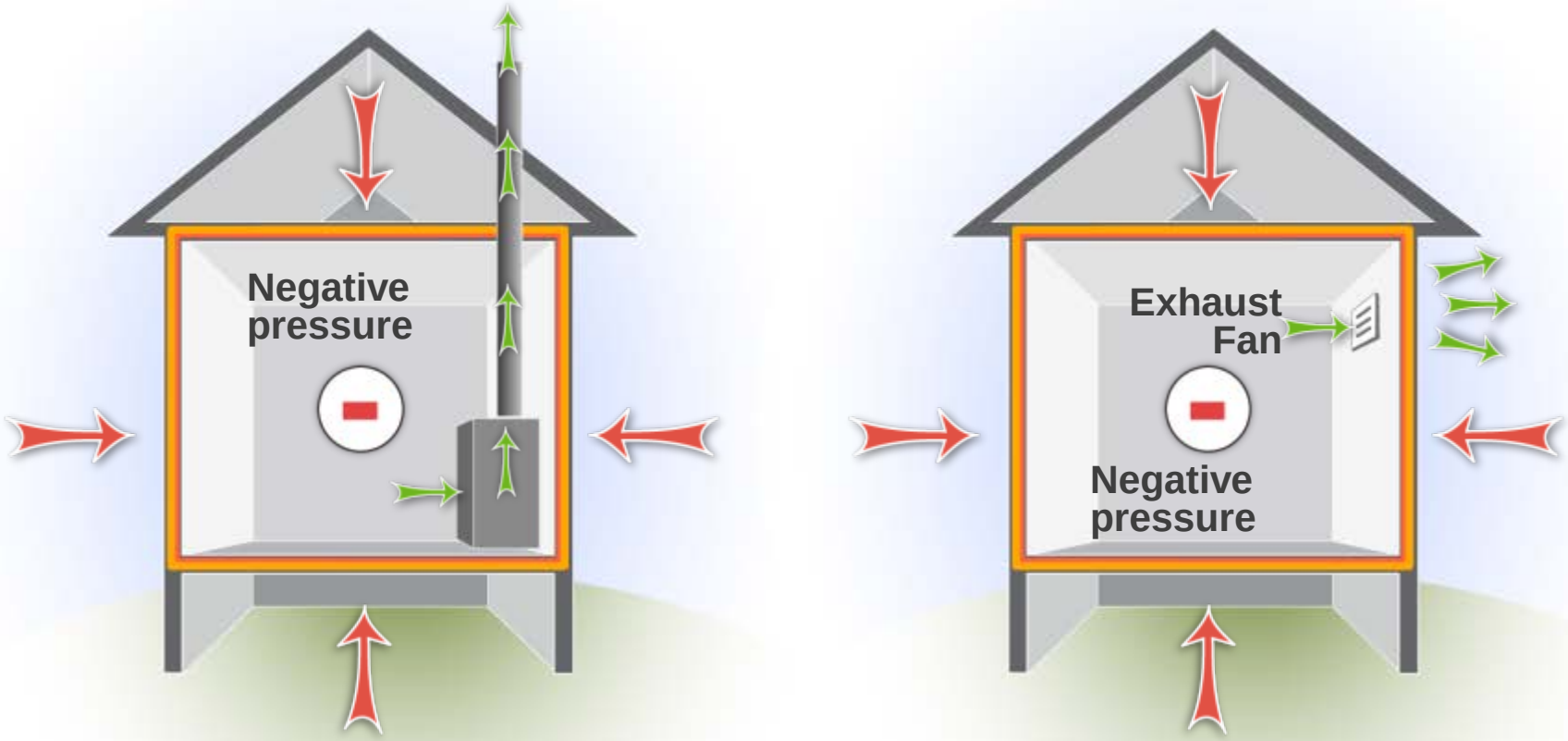
Warmer air rises and escapes out of the top of the house. . .

Which creates a suction that pulls in outside air at the bottom of the house.



Graphic developed for the US DOE WAP Standardized Curricula

Combustion Equipment & Exhaust Fans



Graphic developed for the US DOE WAP Standardized Curricula

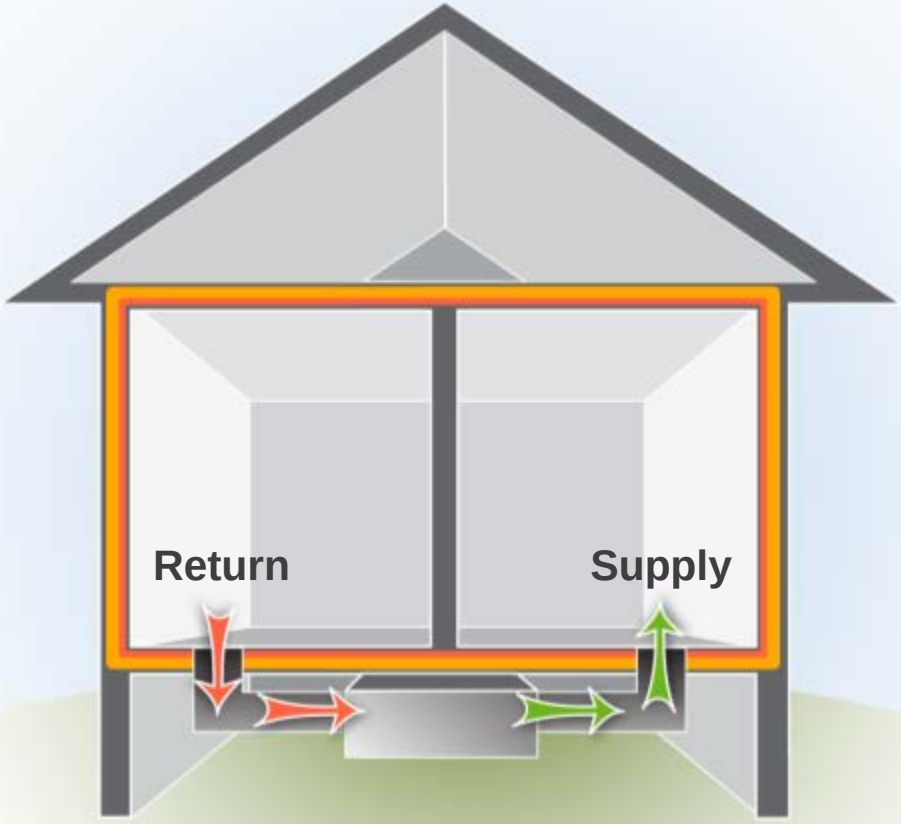
Driving Forces: Duct Leakage

Duct Leakage

Duct leakage can create positive and negative pressures in different areas of the house

The pressures associated with duct leaks can be larger and more important because the driving force is stronger.

All holes are not created equal!

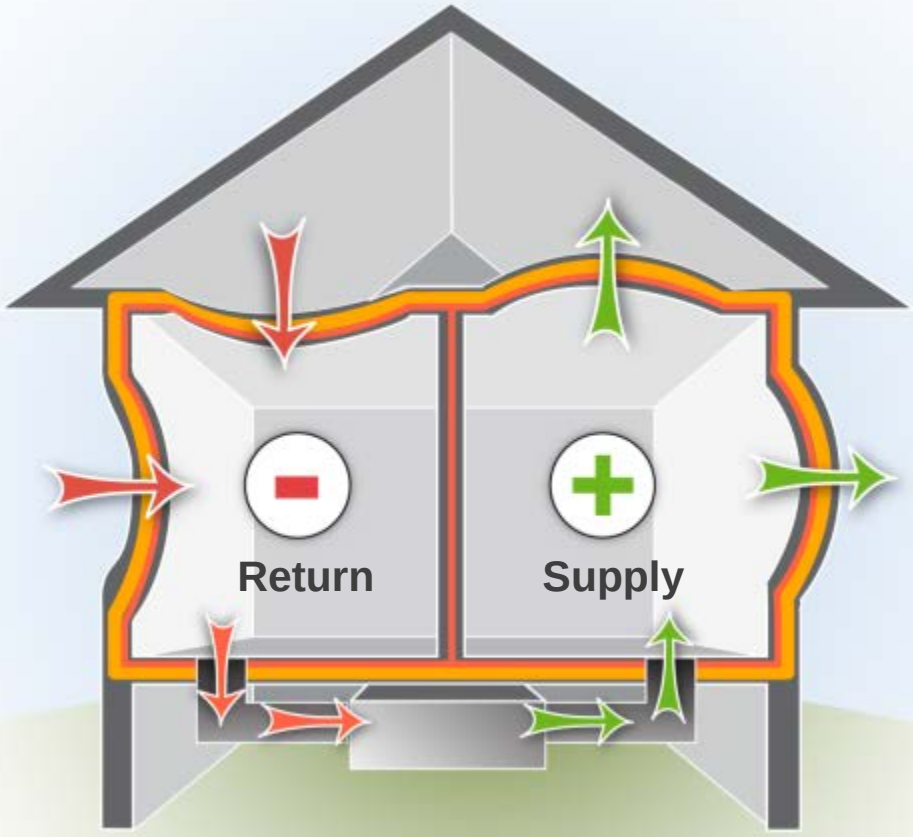


Graphic developed for the US DOE WAP Standardized Curricula

Duct Leakage

Closed doors that prevent supply air from getting back to a return cause positive pressures in those rooms with supply vents. . . .

Meanwhile, starving the return for air, causing negative pressure in the zone where the return is located.

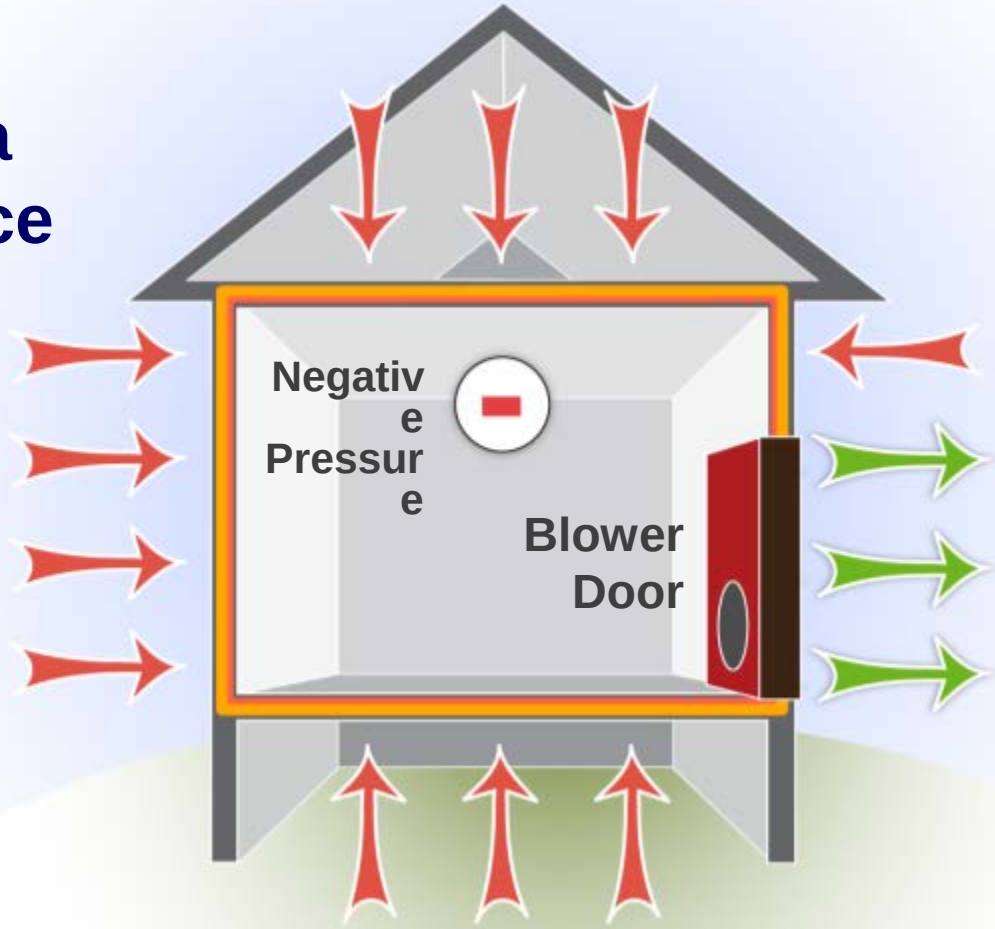


Graphic developed for the US DOE WAP Standardized Curricula

Controlled Driving Force

Use a Blower Door as a Controlled Driving Force

Using the blower door depressurizes the house, drawing air through all the holes between inside and outside.



Graphic developed for the US DOE WAP Standardized Curricula

Summary

- Pressure and thermal boundaries should be continuous and in contact with each other.
- Air carries heat and moisture.
- Air leakage requires a hole and pressure difference.
- Wind, heat, and fans drive pressure differences.
- Duct location and condition can cause room pressure imbalances.
- Blower door is a controlled driving force for quantifying air leakage.

WEATHERIZATION INSTALLER/TECHNICAN FUNDAMENTALS

Identifying and Air Sealing the Building Envelope

Comfort, Safety and Efficiency

A comfortable, safe, and energy-efficient home requires:

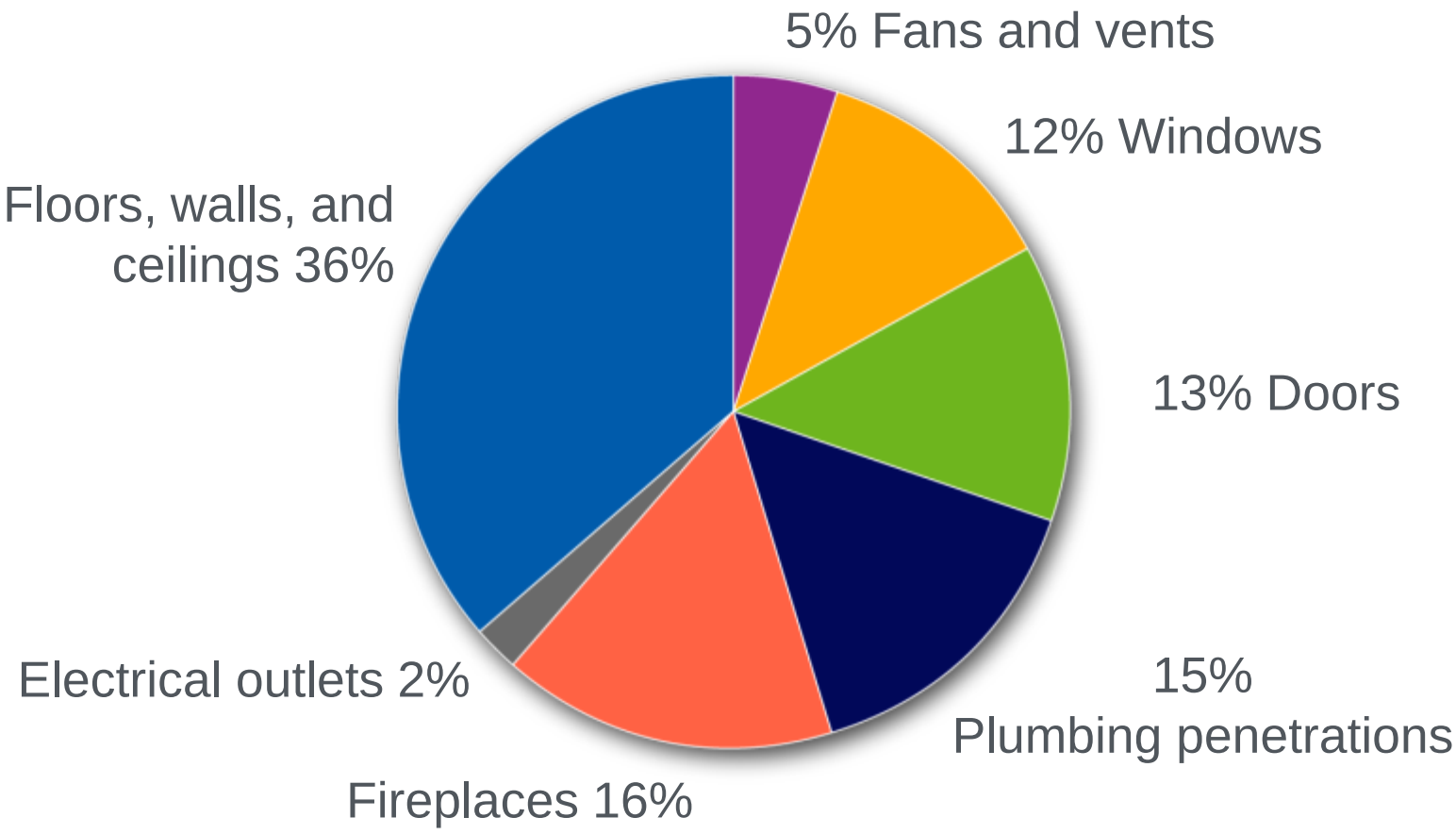
- A fully insulated thermal envelope or thermal boundary.
- A well-sealed air barrier.
- Continuous thermal boundaries and air barriers that are in contact with one another.
- Efficient, properly sized equipment to condition the living space and heat water.
- A well-designed and balanced air distribution system.
- Healthy indoor air quality.

Typical Air-Leakage

IDENTIFYING & AIR SEALING THE BUILDING ENVELOPE

Image courtesy of ENERGY STAR

Primary Air Infiltration Sites



Data courtesy of the California Energy Commission

Finding Air Leaks

Check typical hot spots

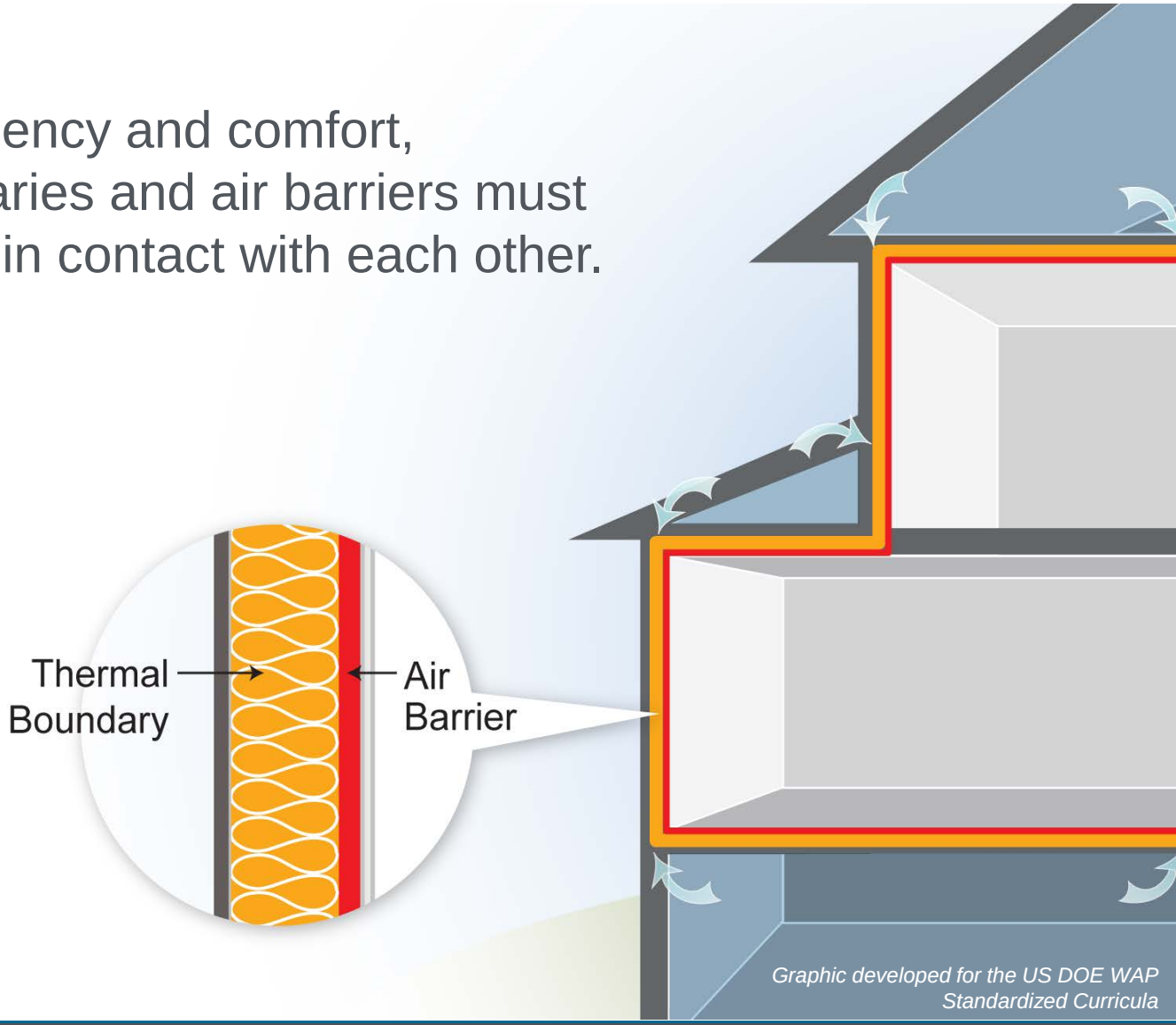
- Flues and plumbing vents
- Wire pathways
- Recessed fixtures (lights and fans)
- Chimney penetrations

Signals

- Blower door, smoke
- Dirty or discolored insulation

Thermal Boundaries & Air Barriers

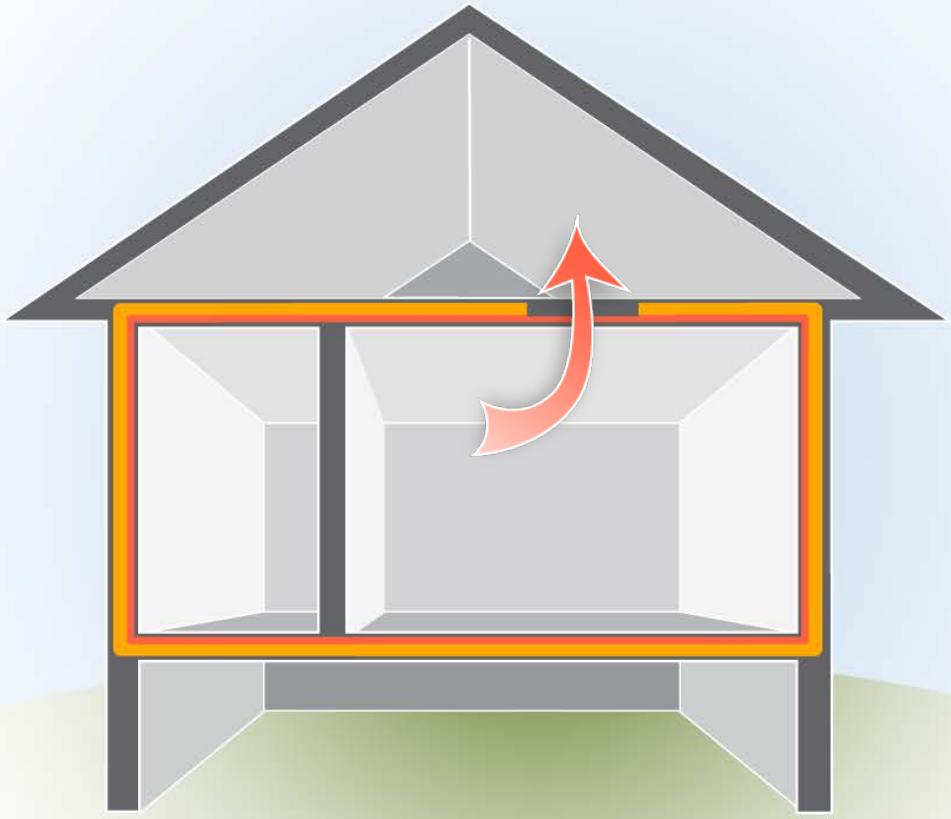
For maximum efficiency and comfort, the thermal boundaries and air barriers must be continuous and in contact with each other.



Graphic developed for the US DOE WAP Standardized Curricula

Thermal Boundaries & Air Barriers

IDENTIFYING & AIR SEALING THE BUILDING ENVELOPE



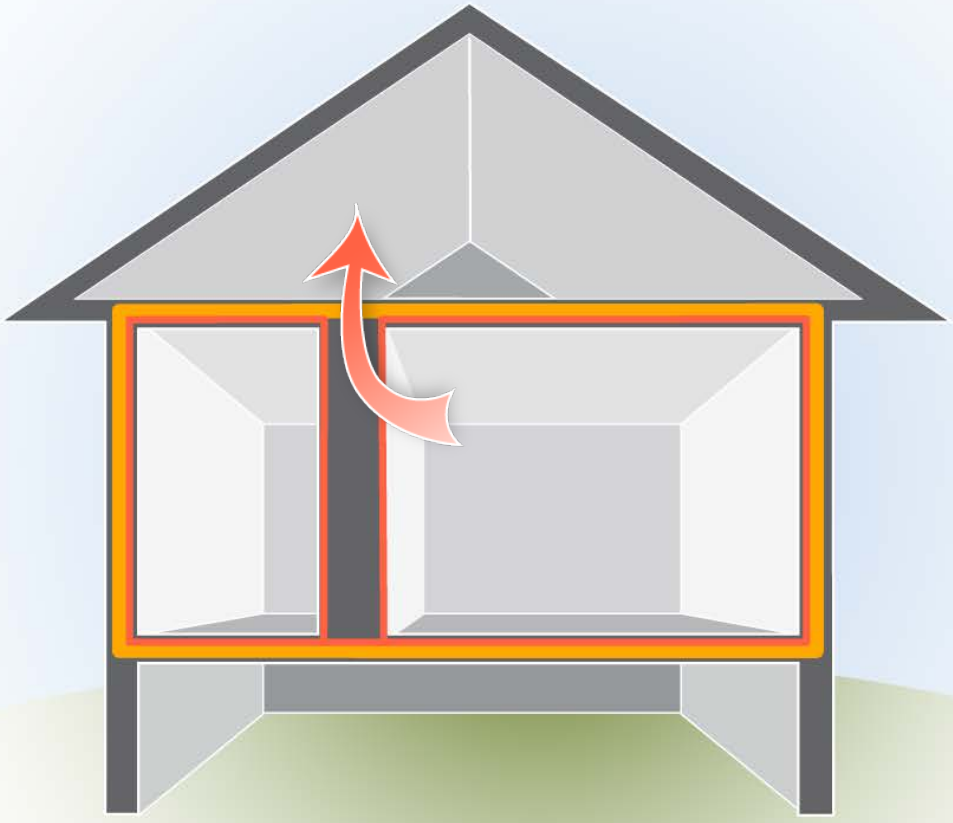
An uninsulated attic hatch is a gap in the attic's thermal boundary.

Air Barrier

Thermal Boundary

Graphic developed for the US DOE WAP Standardized Curricula

Air Barrier



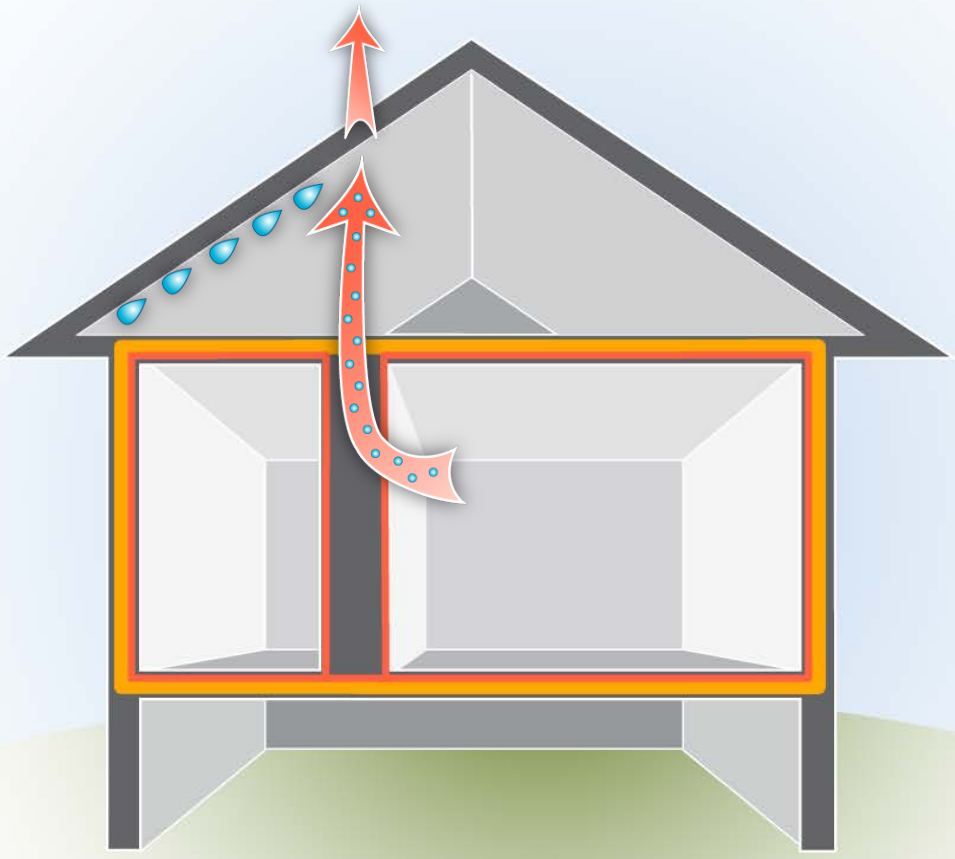
A mechanical chase containing ducts can break the attic's air barrier.

Air Barrier

Thermal Boundary

Graphic developed for the US DOE WAP Standardized Curricula

Moisture



Graphic developed for the US DOE WAP Standardized Curricula

Moisture flows with warm air through breaks in the air barrier, causing damage when it condenses on cool surfaces.

Air Barrier

Thermal Boundary

Photo courtesy of NRCERT

Photo courtesy of NRCERT

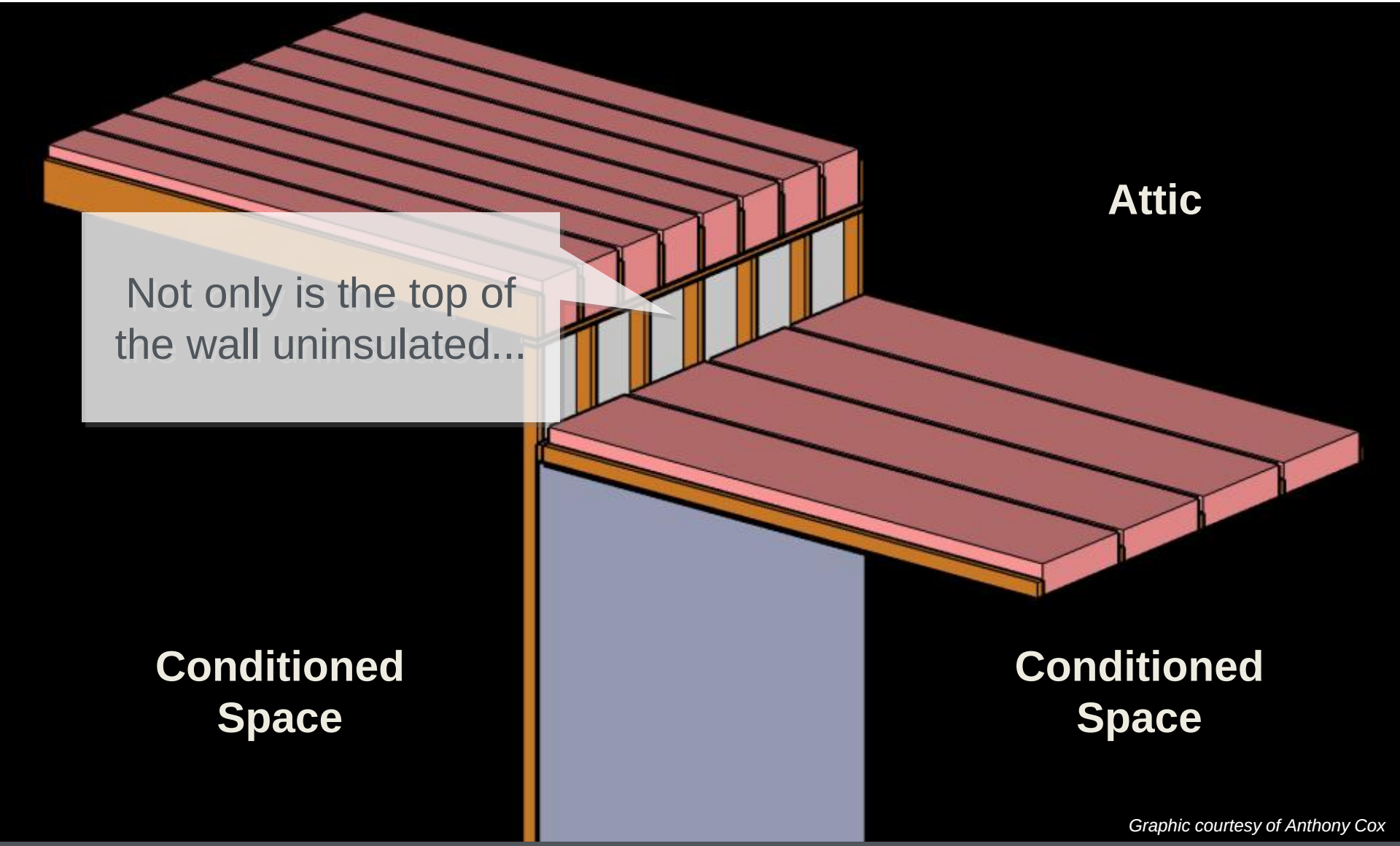
Photo courtesy of NRCERT

Construction Details

Other construction details can result in gaps in pressure and thermal barriers.

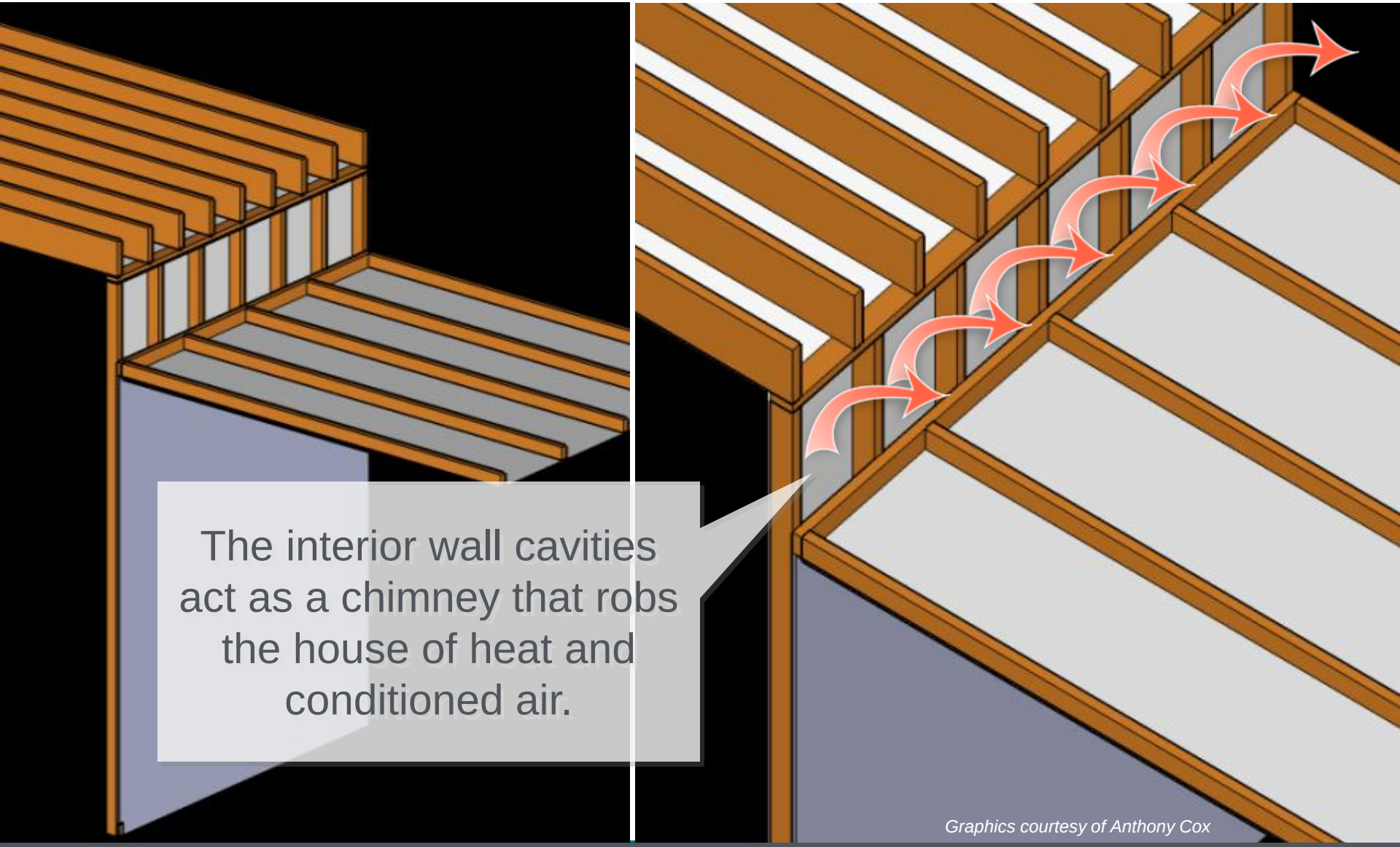
- Changes in ceiling height
- Knee-wall attics
- Walk-up attics
- Dropped soffits
  - o Above kitchen cabinets
  - o In bathrooms
  - o Above vanities
  - o Above built-ins
  - o At duct chases

Changes in Ceiling Height



Graphic courtesy of Anthony Cox

Changes in Ceiling Height

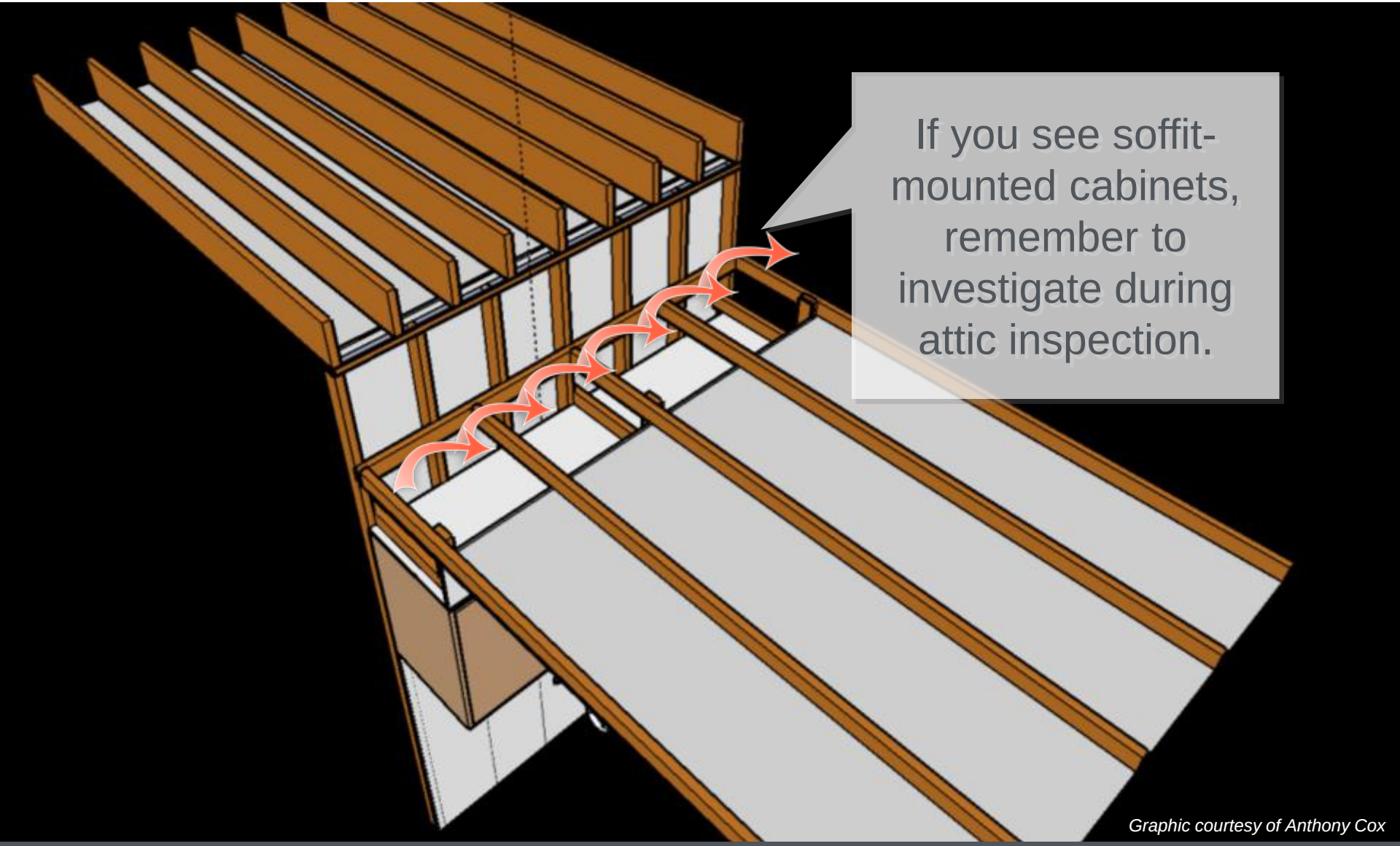


Changes in Ceiling Height

Photo courtesy of the US Department of Energy


Photo courtesy of NRCERT

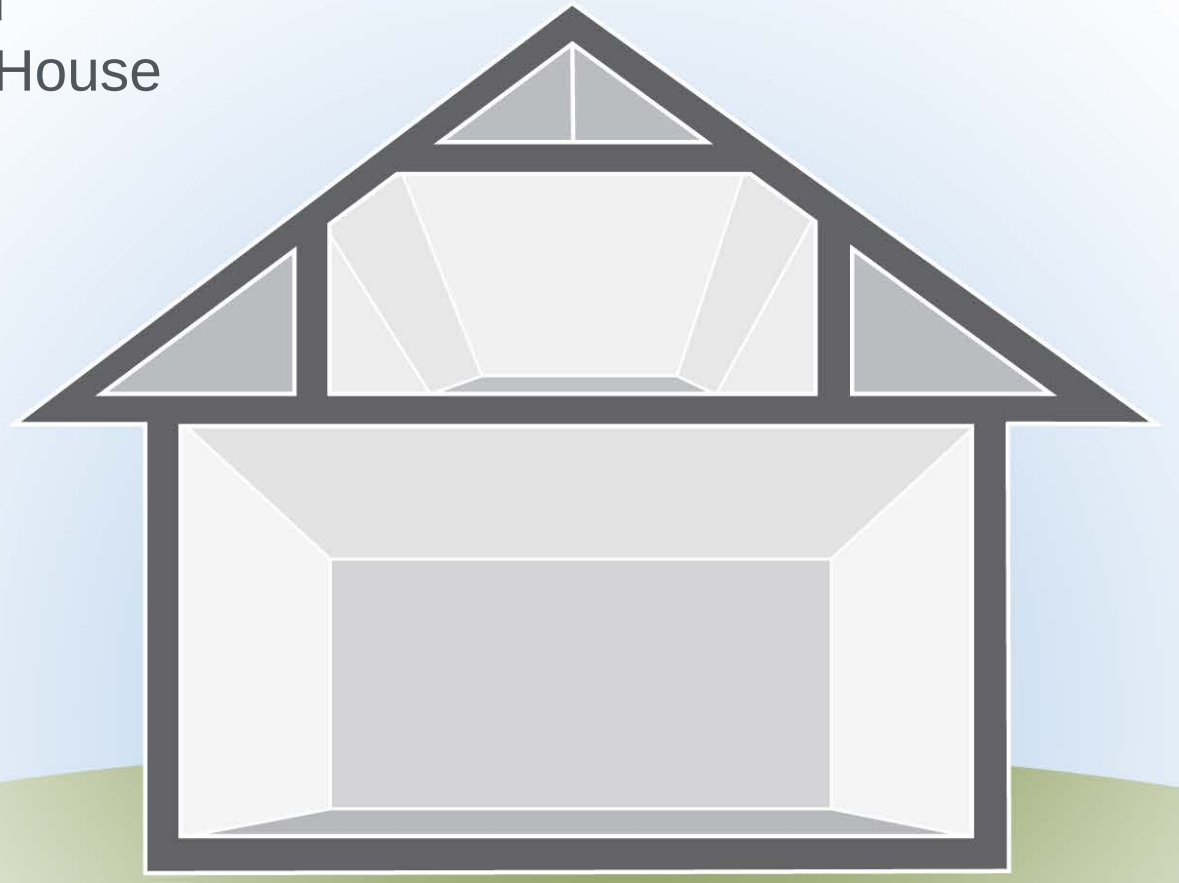
Dropped Soffits



Graphic courtesy of Anthony Cox

Where Is the Air Barrier?

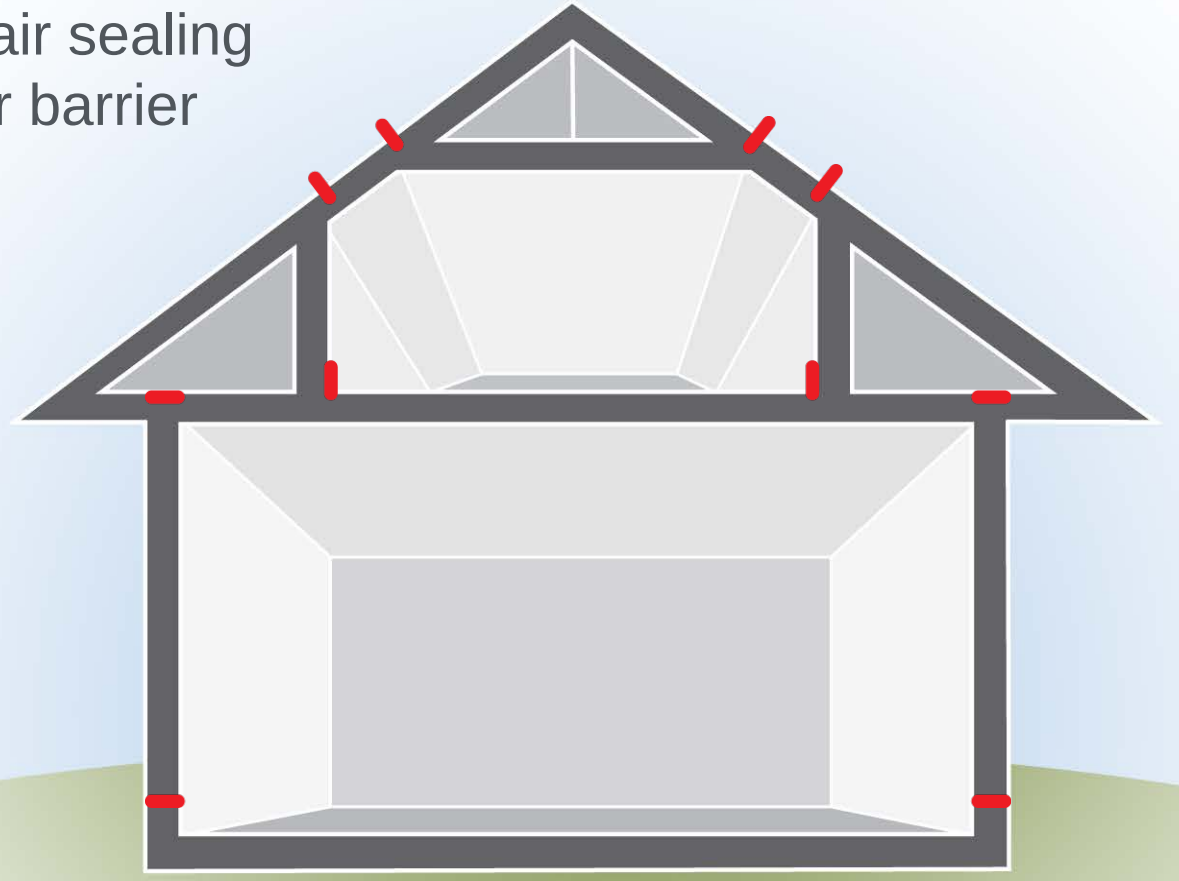
Cape Cod
1½ Story House



Graphic developed for the US DOE WAP Standardized Curricula

Where Is the Air Barrier?

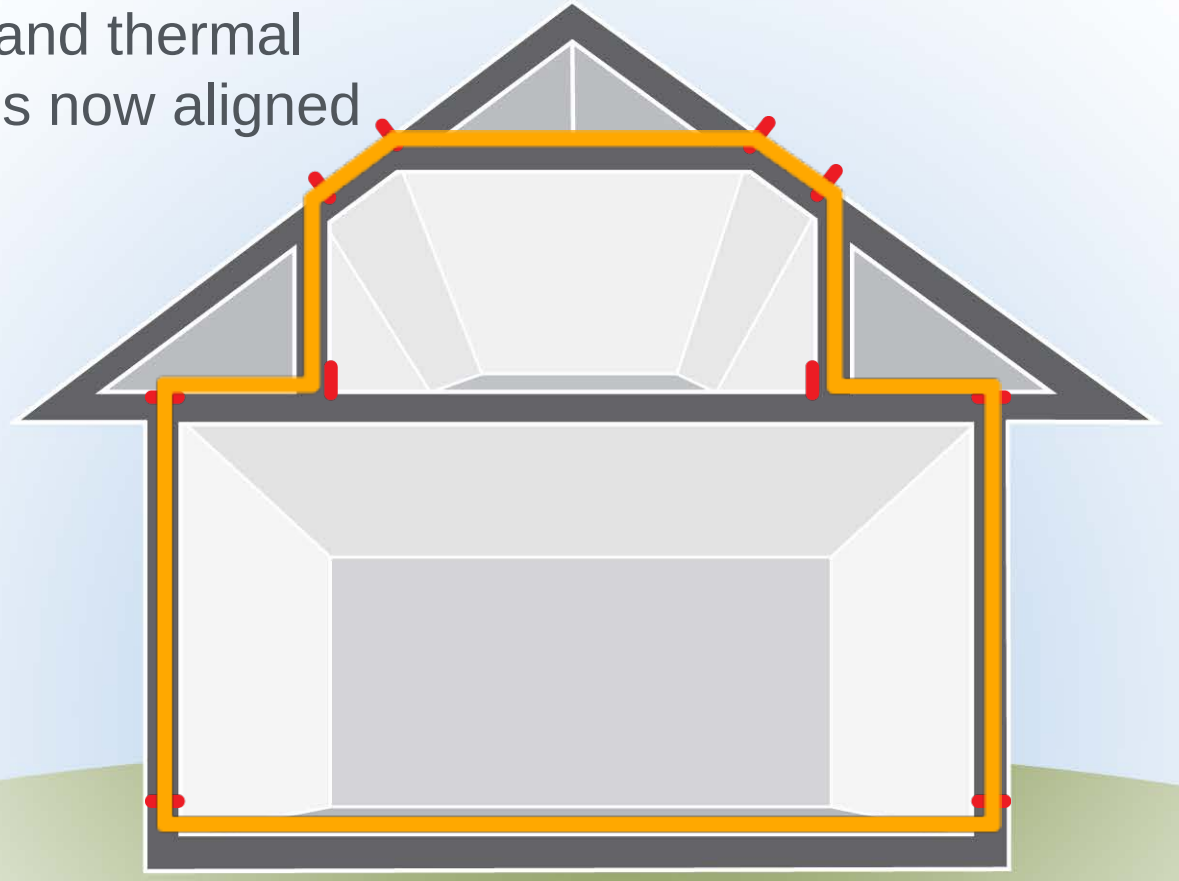
Targeted air sealing defines air barrier



Graphic developed for the US DOE WAP Standardized Curricula

Where Is the Air Barrier?

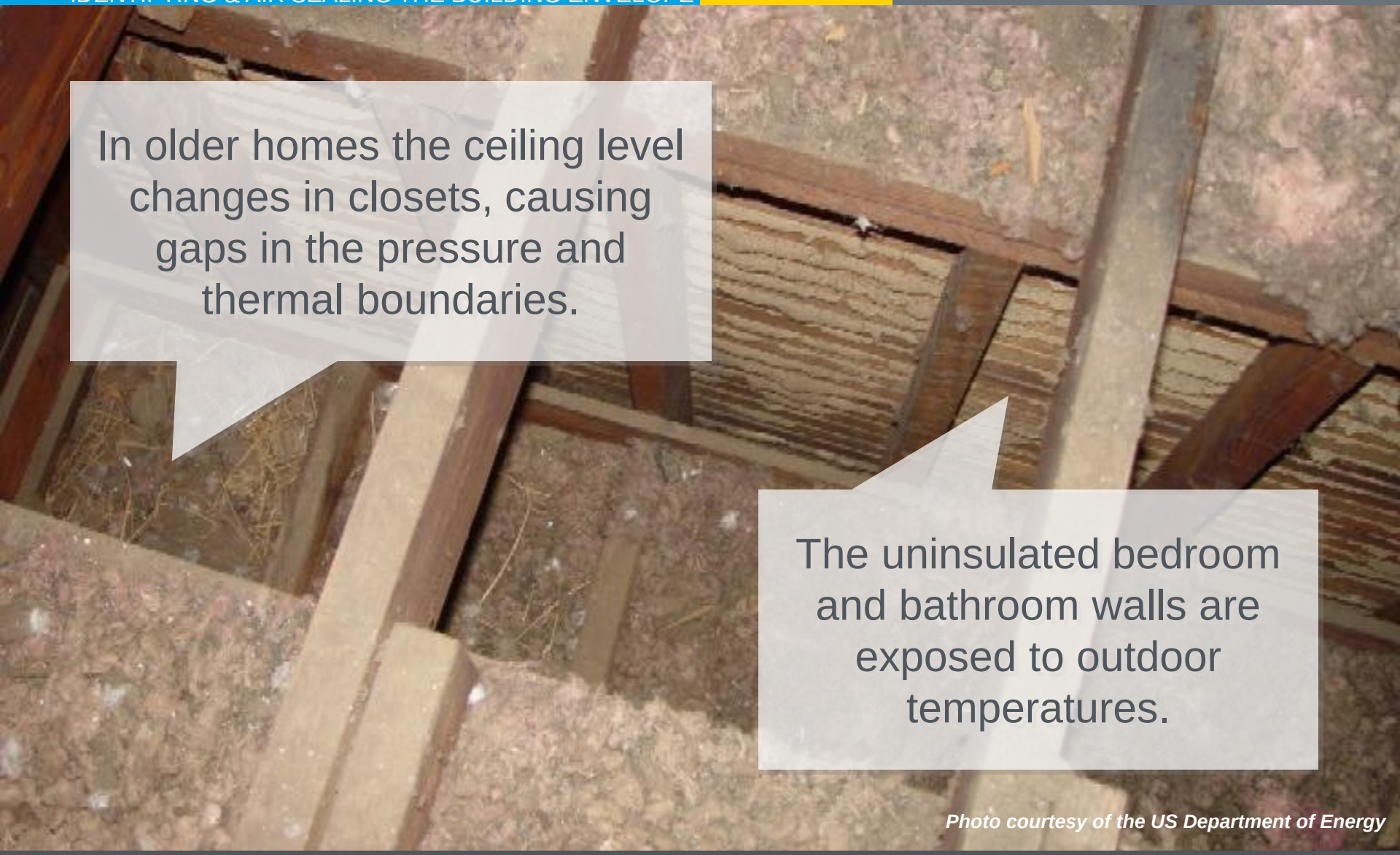
Pressure and thermal boundaries now aligned



Graphic developed for the US DOE WAP Standardized Curricula

Photos courtesy of the US Department of Energy

Changes in Ceiling Height

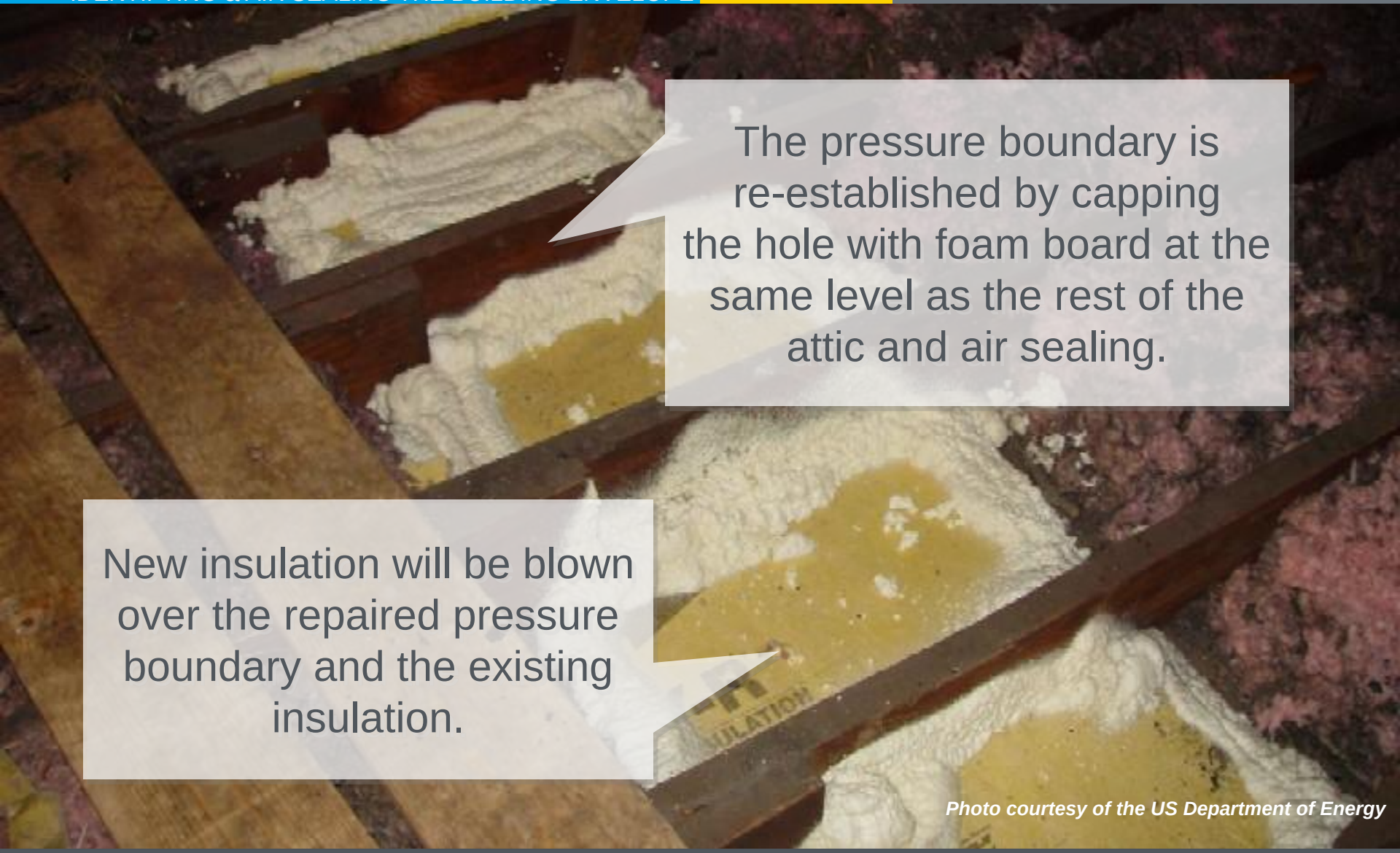


In older homes the ceiling level changes in closets, causing gaps in the pressure and thermal boundaries.

The uninsulated bedroom and bathroom walls are exposed to outdoor temperatures.

Photo courtesy of the US Department of Energy

Changes in Ceiling Height



The pressure boundary is re-established by capping the hole with foam board at the same level as the rest of the attic and air sealing.

New insulation will be blown over the repaired pressure boundary and the existing insulation.

Photo courtesy of the US Department of Energy

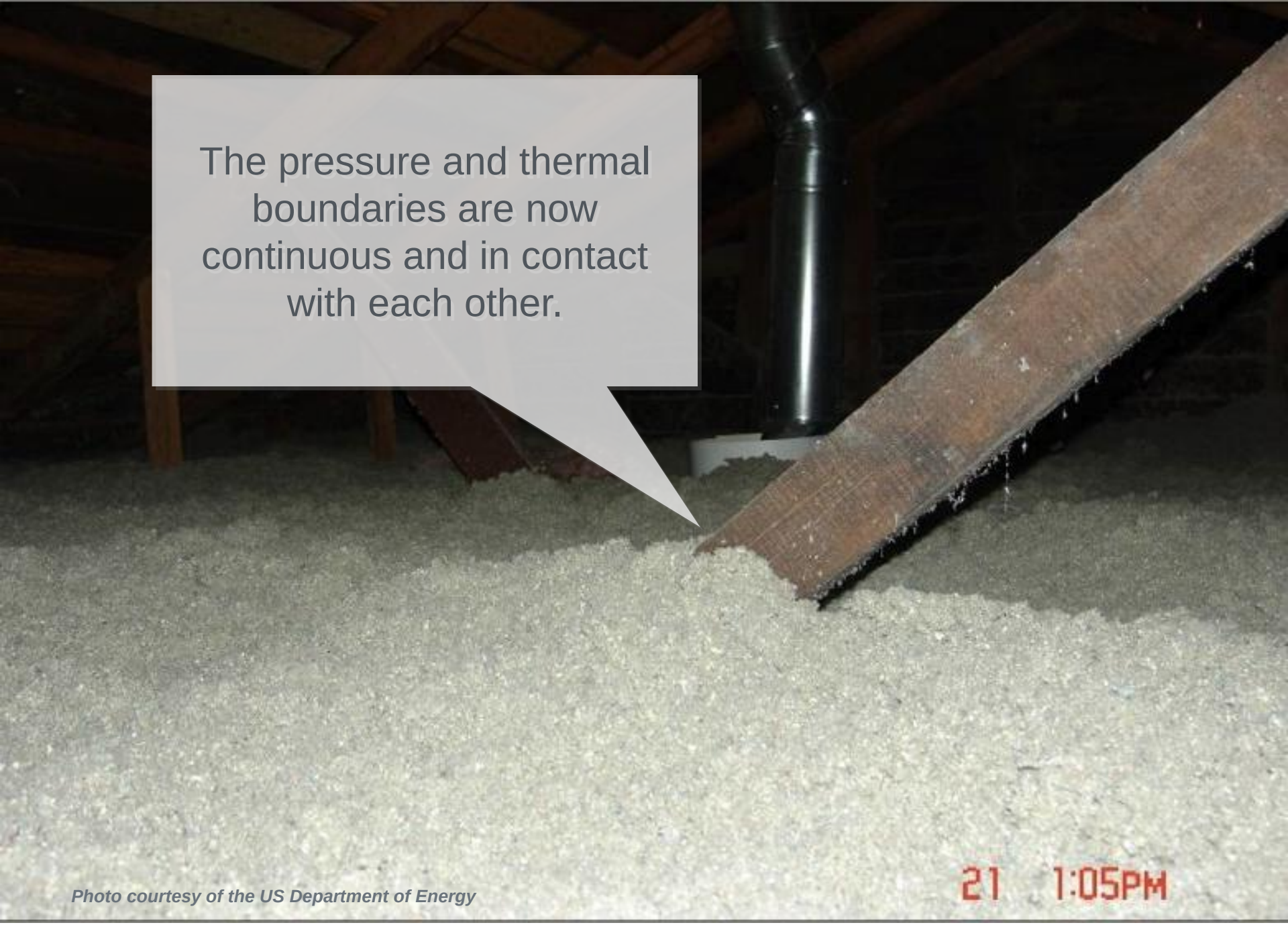
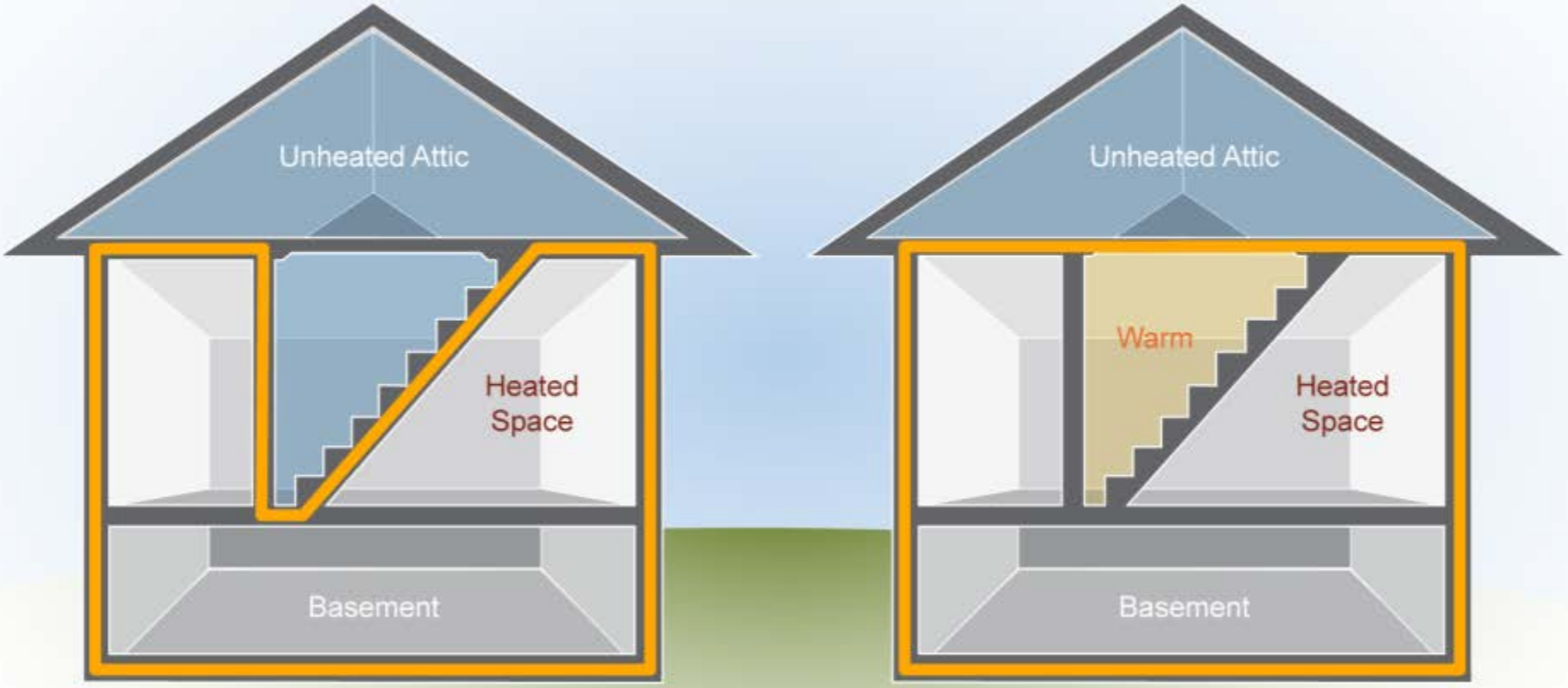


Photo courtesy of the US Department of Energy

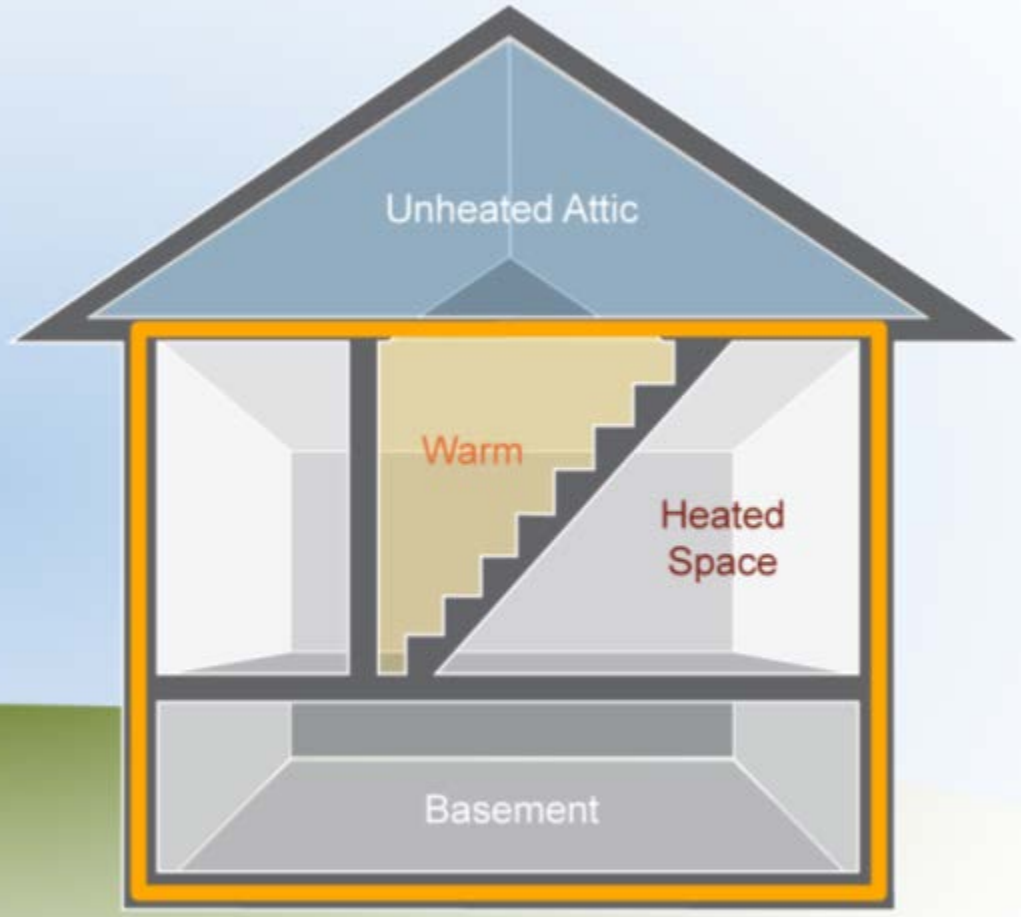
Walk-Up Attics

Where Is the Pressure Boundary? Where Should It Be?



Graphic developed for the US DOE WAP Standardized Curricula

Walk-Up Attics



Graphic developed for the US DOE WAP Standardized Curricula

If the client does not use the attic often:

- An insulated, airtight cover can be installed on top of the stairwell.
- The pressure and thermal boundaries are aligned at the level of the attic floor.

This approach brings the stairwell into the conditioned space.

It is also cheaper and faster than the alternative.

Summary

- For maximum efficiency and comfort, the thermal and pressure boundaries must be continuous and in contact with one another.
- Electrical and mechanical chases, missing top plates, knee walls, dropped soffits, and changes in ceiling height are common trouble spots.
- Targeted air sealing defines the pressure boundary.

WEATHERIZATION INSTALLER/TECHNICIAN FUNDAMENTALS

Moisture Barriers

Symptom #1

Excessive window condensation

Symptom #2

Frost on underside of roof sheathing

Moisture Sources

- Foundations
- Unvented space heaters
- Unvented dryers
- Disconnected ventilation fans
- Drying wood indoors
- Excessive mechanical or passive humidification

These water stains are a result of fan venting into the attic.

Sources of Water Vapor

SOURCES OF WATER VAPOR

Source	Quarts per Day
Construction materials first year	40
Standing water in basement	30
Damp basement or crawl space	25
Greenhouse connected to house	25
Humidifier - large	20
Drying 1 cord of firewood	16
Clothes dryer vented to inside	13
Respiration/perspiration - 4 people	4.7
Clothes washing	2.1
Unvented gas range	1.3
Cooking without lids	1.0
Houseplants - average number	0.5
Dish washing	0.5
Floor mopping	0.4
Showering/bathing	0.3

Important Terms and Concepts

- Condensation: Water vapor transformed to liquid water.
- Evaporation: Liquid water transformed to water vapor.
- Absolute Humidity (vapor pressure): The ratio of water vapor to a given volume of air.
- Relative Humidity (RH): The ratio of the amount of moisture in the air compared to amount of moisture that the air can hold.
- Dew Point: The temperature at which condensation occurs.

RH: Things to Remember

- Warm, wet air contacting cold surfaces creates condensation instantly.
- Cold winter air typically contains very little moisture and therefore has a low RH. When that air is heated, the RH drops even lower.
- Warm air can hold more moisture than cold air.
- RH below 15% can lead to respiratory issues, and other problems.

Visual Assessment – Exterior

MOISTURE BARRIERS

Driveway slopes back into foundation, carrying moisture there.

A disconnected downspout causes water to pour down walls during weather events.

Photos courtesy of PA Weatherization Training Center

Basement moisture problems may be traced back to poor exterior drainage.

Foundation Moisture Issues

Foundation spaces account for the vast majority of moisture and indoor air quality (IAQ) issues in houses.

- Standing water is often caused by poor exterior or interior drainage.
- Many homes don't have sump systems; many homes have sump systems that don't work.
- Condensation on cool surfaces during warm, humid periods can cause moisture problems.
- Saturated building and cellulose-based materials lead to mold problems.
- Resolve all major moisture issues before weatherizing a home.

What's the difference between a basement and a pond? Sometimes very little.

Photo courtesy of PA WTC

Crawl Space Condensation

Symptoms

- Wet wood
- Condensation on foundation surfaces

Possible Reasons

- High ground moisture source
- Warm humid air entering vents from outside
- Crawl space surfaces are below the dew point of the outside air

Water droplets of condensation on AC ducts

Crawl Space Case Study

Symptoms

- Wet wood
- Condensation on foundation surfaces

Possible Reasons

- High ground moisture source
- Warm humid air entering vents from outside
- Crawl space surfaces are below the dew point of the outside air

Conditioned crawlspace with air sealed and insulated walls

Control Strategies

- **Install a ground vapor retarder.**
- **Control moisture sources and remove susceptible materials.**
- **Consider converting to a conditioned crawl space.**

Control Strategies

MOISTURE BARRIERS

- Install a ground vapor retarder.
- Control moisture sources and remove susceptible materials.
- Consider converting to a conditioned crawl space.

Attic Case Study

Floored Attic and First Condensing Surface

Attic Case Study

- Symptoms
  - Condensation or mold growth on attic surfaces (rafters, sheathing or underside of flooring)
- Possible Reasons
  - Moderate to high interior moisture source
  - Attic surface temps are below the dew point of the indoor air
  - Air leaks to attic
- Control Strategies
  - Source control
  - Air seal the attic

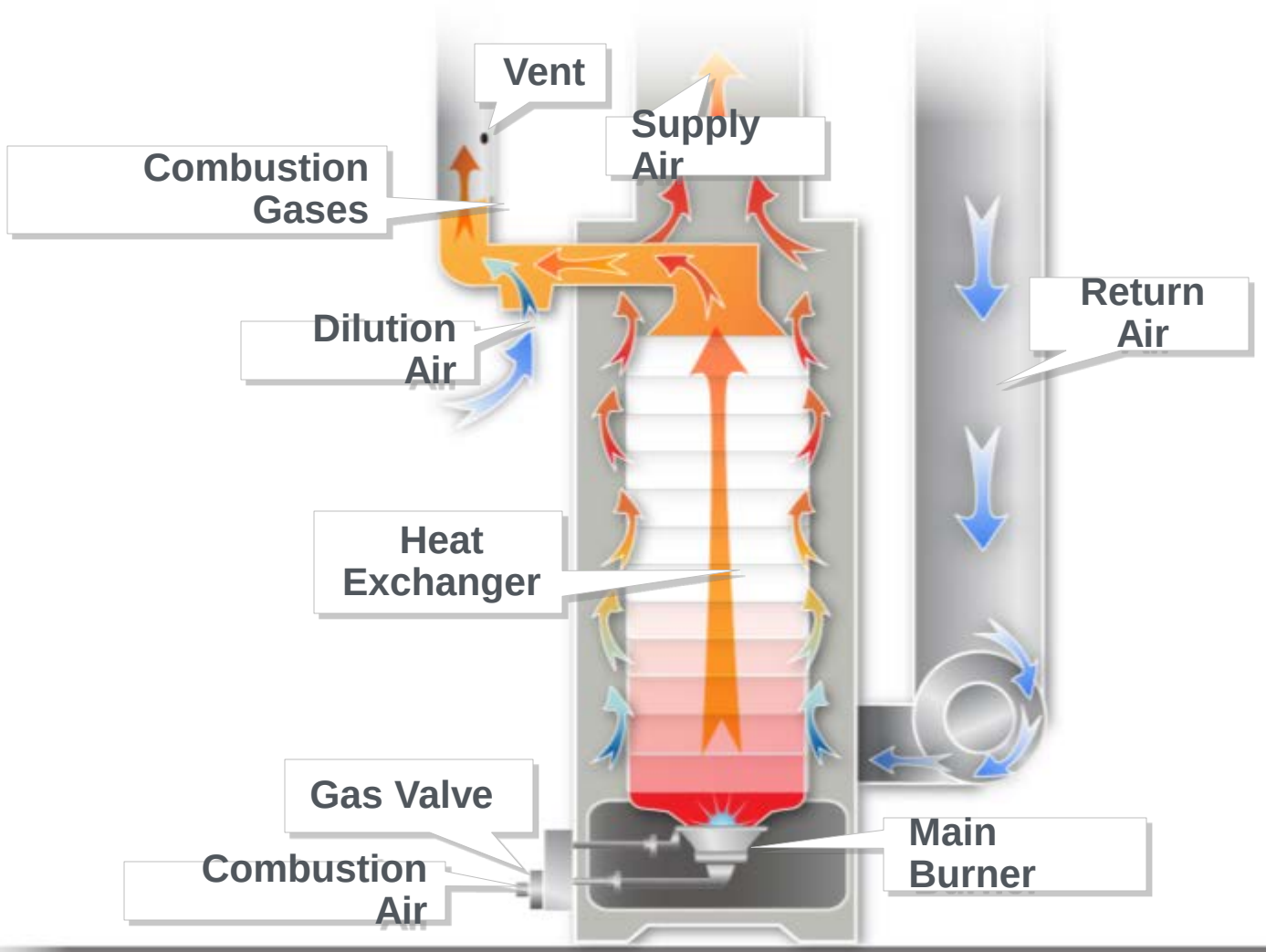
Summary

- Identifying the source of moisture should inform moisture solutions.
- Understanding the effects of temperature and vapor pressure on RH can help identify solutions.
- Source control, air sealing, ventilation, and thermal improvements are important moisture mitigation strategies.
- Photos and diagnostic equipment help document existing conditions.
- Follow proper installation guidelines for moisture barriers and roof repair.

WEATHERIZATION INSTALLER/TECHNICIAN FUNDAMENTALS

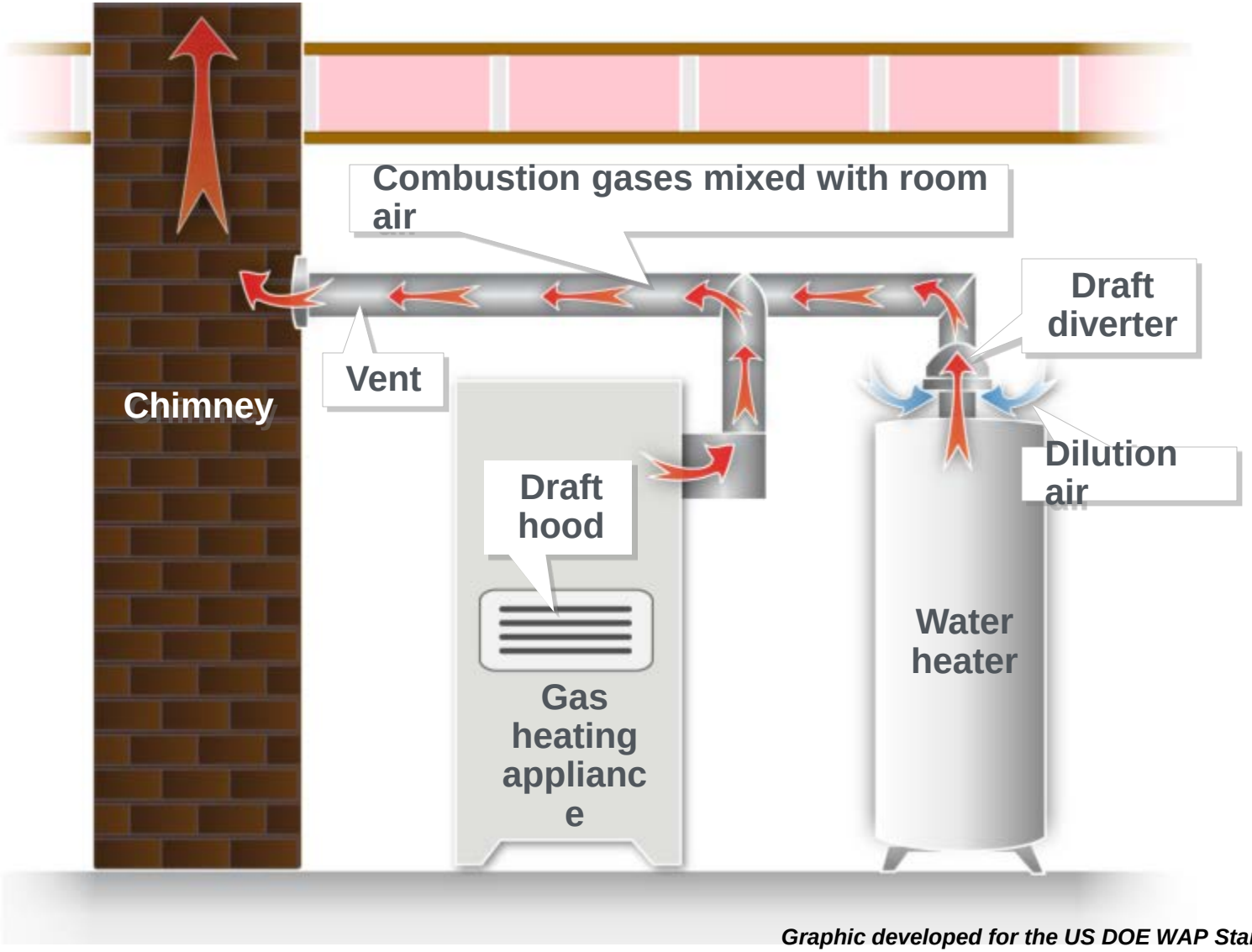
Identifying Mechanical Systems and Improving Duct Systems

Combustion, Distribution & Venting



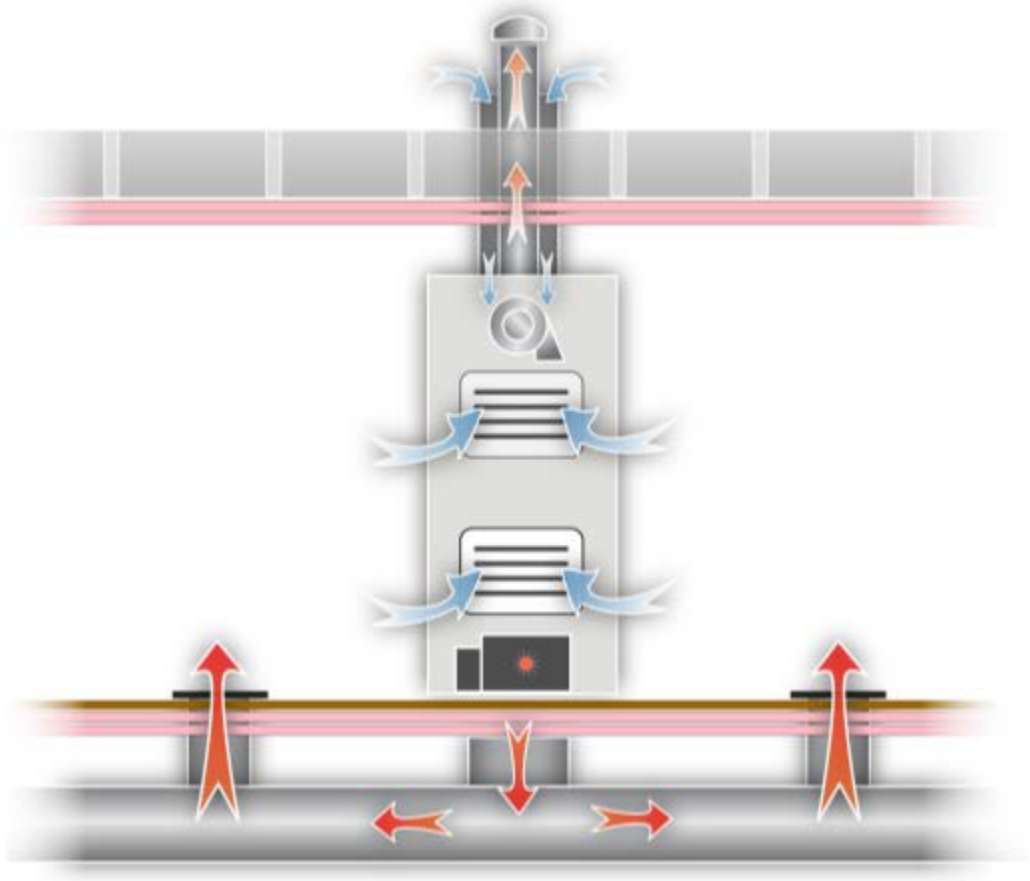
Graphic developed for the US DOE WAP Standardized Curricula

Chimney and Vent Connectors



Graphic developed for the US DOE WAP Standardized Curricula

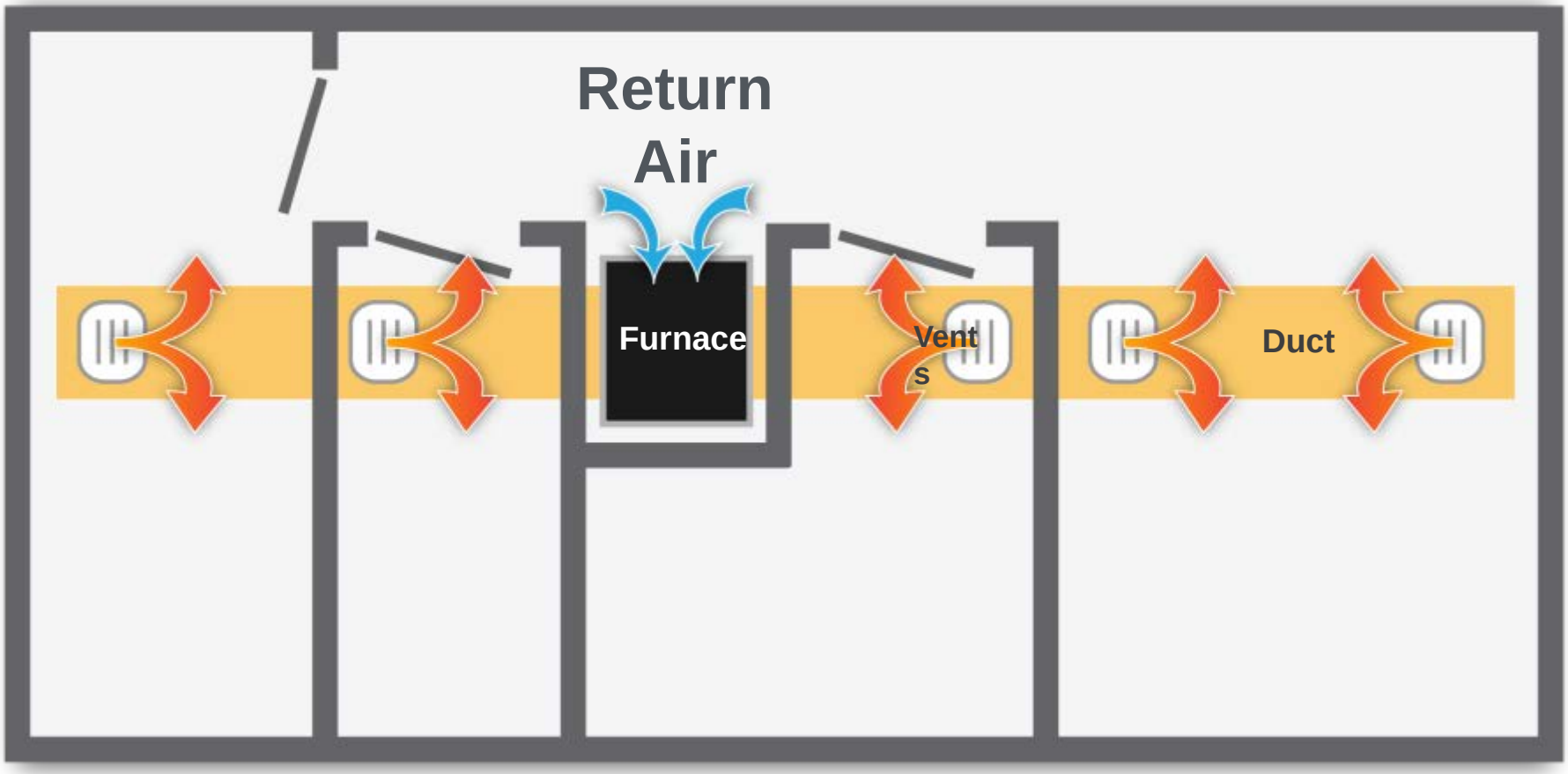
Forced Air System Operation #1



A typical mobile home downflow distribution system

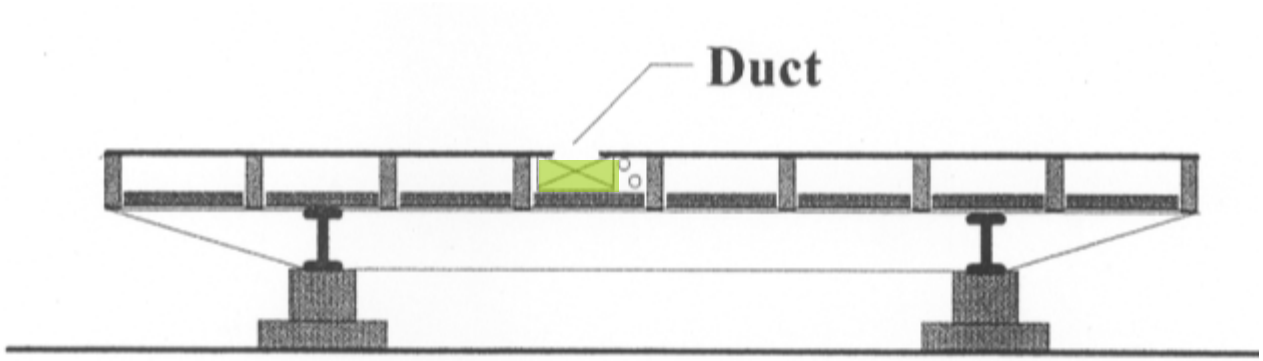
Graphic developed for the US DOE WAP Standardized Curricula

Forced Air System Operation #2

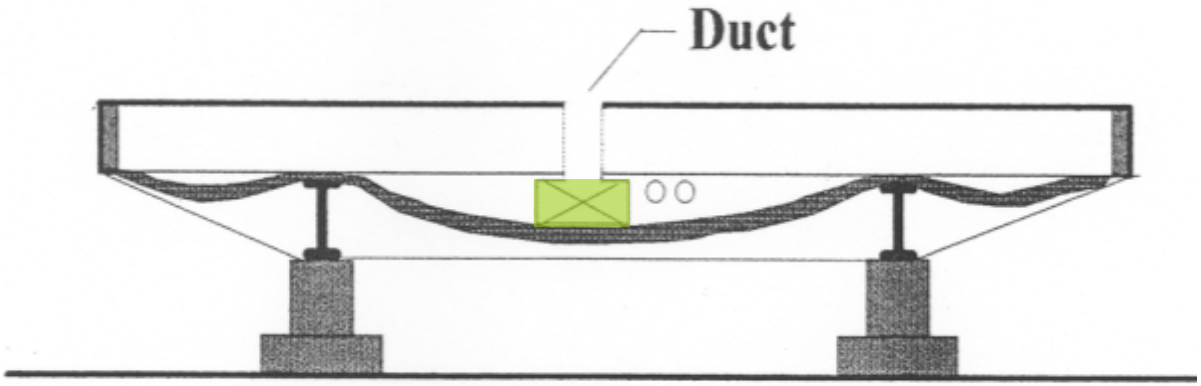


Graphic developed for the US DOE WAP Standardized Curricula

Duct Location



Lengthwise Floor Joist System



Crosswise Floor Joist System

Images courtesy of PA WTC

Problems and Opportunities

Visual Checks #1

Duct registers are common leakage sites.

Photos courtesy of PA WTC

Repairing and Sealing Ducts - Review

Concentrate on the following locations:

- Risers
- Ends
- Branch ducts
- Furnace plenum

- You may need to cut the rodent barrier to access some leaks.
- Never use duct tape.
- Mechanically fasten components where necessary.

Chimneys and Vents

Check for:

- Connections, obstructions
- Holes
- Sound liner
- Slope of horizontal runs
- Extend 3’ above roof penetration
- Appropriate type and size for the appliance
- Proper diameter

Chimneys and Vents

Reduced vent connector out of compliance with code

No vent connector

Water Heaters

Burn marks above the burner compartment are evidence of flame roll out.

Spillage of flue gases or insufficient draft is often a result of an improper installation such as this.

Summary

- Furnaces heat air and use ducted distribution systems.
- Boilers heat water and transport heat through the living space through pipes connected to radiators.
- Cooling systems can be packaged or split systems. If the condenser and coils are in separate locations, it is a split system.
- Most ducts are very prone to leakage.
- Diagnosing and repairing duct leakage is the single, most cost-effective measure you can apply to many mobile homes.
- Effective duct sealing is possible through the use of innovative duct sealing materials.
- Other duct improvement measures, such as cleaning, removing obstructions, and system balancing can improve comfort and lower fuel bills.

WEATHERIZATION INSTALLER/TECHNICAN FUNDAMENTALS

Combustion Safety

House as a System

The House is a System

When we air seal and insulate,
we change how the house operates.

We need to inspect and test to make sure
the house is safe when we leave.

House as a System

Making the house tighter could:

- Make existing problems worse.
- Create new problems.

These existing and new problems could be lethal.

- Gas leaks
- Carbon monoxide
- Backdrafting
- Moisture and mold

Most of the potentially lethal problems involve combustion appliances, like the furnace or water heater.

What to Inspect

What do we inspect on combustion appliances?

- Chimney
- Vent pipe
- Fuel leaks
- Wiring
- Heat exchanger
- Distribution (fan and ducts, if applicable)

What to Test

What do we test for on combustion appliances?

- Fuel leaks
- Correct operation of safety devices
- Fuel input rate
- Proper combustion air
- Worst-case draft
- Carbon monoxide
- Combustion efficiency

Combustion Analyzers

Bacharach
Fyrite Pro

Bacharach
Fyrite Insight

Testo 327-1

Images courtesy of Bacharach and Testo

Inspection – Chimney and Vent Pipe

- Is it rusty? Are there holes? Is it falling apart?
- Is the chimney blocked?
- Is it too short?
- Are the correct materials used? Is it the right kind of vent pipe?
- Is it too small or too large for the appliances connected to it?
- Does it need a chimney liner?

Photo courtesy of NRCERT

Photo courtesy of NRCERT

Photo courtesy of NRCERT

Photo courtesy of NRCERT

Inspection – Distribution (Ducts)

- Is there a return in the combustion appliance zone?
- Is the filter slot too big and uncovered?
- Is the filter present? Is the filter dirty?
- Is the air handler fan clean?

Summary

- For combustion safety, visual and diagnostic inspection of combustion appliances is critical to protecting clients and workers.
- Negative home pressure, chimney obstructions, or insufficient combustion air can cause unsafe levels of CO.
- CAZ worst-case draft testing reveals potentially dangerous conditions.
- Filters, ducts, and air handling units are part of combustion safety.

WEATHERIZATION INSTALLER/TECHNICIAN FUNDAMENTALS

Dense-Pack Sidewall Insulation

It Works

DENSE-PACK SIDEWALL INSULATION

“It is not unusual to reduce overall house leakage by 30% to 50% by dense-packing walls and other closed-in cavities.”

- Home Energy Magazine, Nov/Dec 1995

It Works If…

DENSE-PACK SIDEWALL INSULATION

- Proper (cost-effective) R-value
- Uniform density throughout cavity
- Pack to 3.5 lbs/ft^3

Maintain Equipment

DENSE-PACK SIDEWALL INSULATION

- Check belts and other moving parts.
- Graphite?
- Check filters with every use.
- Check static pressure (2.9 psi at takeoff and end of hose).
- Ensure there is enough hose for the job, no leaks.
- Check seals.

Photos courtesy of the US Department of Energy

Insulation Blowing Tips

DENSE-PACK SIDEWALL INSULATION

- Initially adjust your blowing machine settings at “high-air” and “low-material feed.”
- Gradually increase material feed to maximize production while minimizing clogs.
- Hose transitions should be gradual.
- Use at least 100 feet of hose for good maneuverability while working.
- Have someone on the crew continually check inside and underneath the home for spills.

Photos courtesy of WV GOEO

Hose Pressure Gauge

DENSE-PACK SIDEWALL INSULATION

Photos courtesy of the US Department of Energy

Inspect Before You Start

- Holes or weaknesses in interior walls
- Location of pocket doors
- Wiring
- Ducts and pipes
- Electrical fixtures
- Pre-1978 home? *Lead-safe work practices*

Determine Fill Strategy

- Blow in from attic if possible.
- Interior
- Exterior
- Drill at top, bottom, middle?

Trouble-Shooting or Shooting Trouble?

DENSE-PACK SIDEWALL INSULATION

If you've blown for more than *four minutes* without reaching proper density, find out where cellulose is going!

Photo courtesy of the US Department of Energy

Summary

- Dense-pack sidewall insulation is effective when installed correctly.
- Target = 3.5 pounds/cubic foot.
- Aim for uniform density throughout the wall cavity.
- Maintain equipment; inspect walls; and drill, fill, and repair.
- Avoid accidents; check the house frequently.

WEATHERIZATION INSTALLER/TECHNICIAN FUNDAMENTALS

Electrical Safety in the Home

The Danger

- An average of one person is electrocuted in the home every 36 hours.
- Electrical incidents are far more likely to be fatal than other types.
- There are four main types of electrical injuries:
  - Electrocution (death due to electrical shock)
  - Electrical shock
  - Burns
  - Falls

Courtesy of EFCOG Electrical Improvement Project

Electrical Terminology

- Current – the movement of electrical charge
- Resistance – opposition to current flow
- Voltage – a measure of electrical force
- Conductors – substances, such as metals, that have low resistance to electricity
- Insulators – substances, such as wood, rubber, glass, and bakelite, that have high resistance to electricity
- Grounding – a conductive connection to the earth which acts as a protective measure

Courtesy of EFCOG Electrical Improvement Project

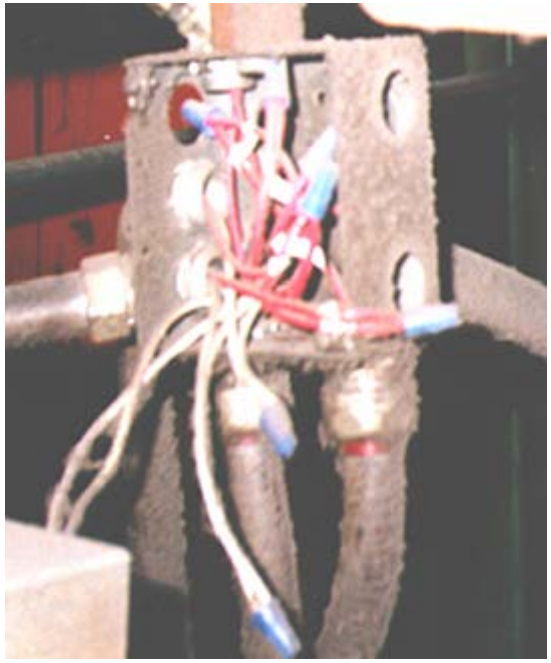
Recognizing Electrical Hazards

Photo courtesy of US Department of Energy

Open Junction Box

Recognizing Electrical Hazards

- Junction boxes, pull boxes, and fittings must have approved covers in place.
- Approved covers on boxes
- No missing knockouts



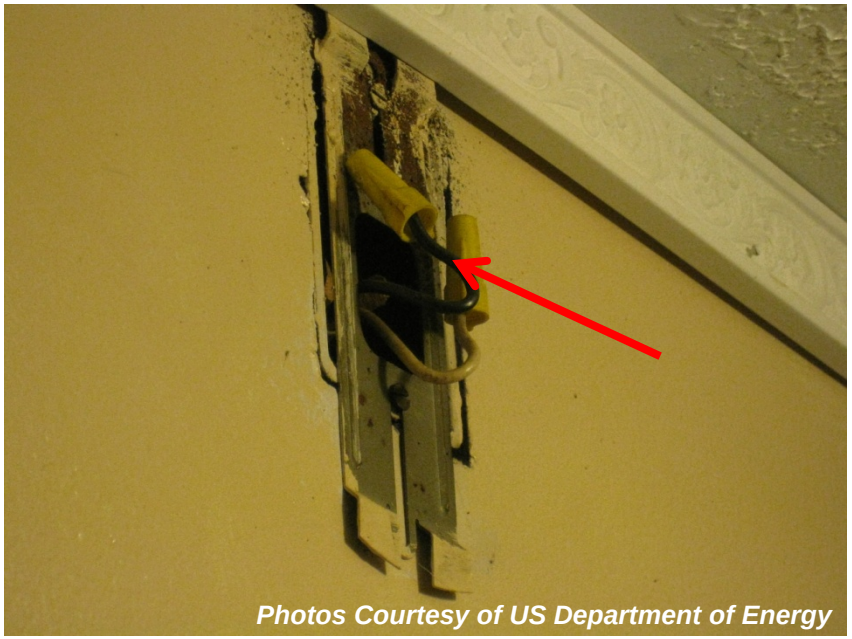
Does this meet the requirements for safety?

Image courtesy of EFCOG Electrical Improvement Project

Recognize Electrical Hazards

- Is insulation on wiring missing or deteriorated?
- Are wires properly clamped, connected, and enclosed?

Identifying Electrical Hazards



Open Wire Splices

Insulating over Knob & Tube Wiring

Knob and Tube Retrofits

Photo courtesy of the US Department of Energy

Damming around knob and tube wiring

Summary

- Codes and rules related to electrical safety include the IRC, NEC, and DOE Guidance.
- Common electrical safety hazards in homes include uncovered wiring splices, frayed wiring, and overloaded knob and tube wiring.
- Notify the proper authority and do not attempt electrical repairs unless qualified to do so.

Contact Information

Brandon Kjelden
Energy and Rehab Coordinator
Southeastern ND Community Action Agency
3233 University Dr. South
Fargo, ND 58104
(701) 232-2452
brandonk@sendcaa.org
www.sendcaa.org