HOME IMPROVEMENTS FOR COMFORT & EFFICIENCY AND FREE MONEY TO HELP DO THEM

Arlington Forest Civic Association
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HOME ENERGY MEDICS

Home Energy Medics
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Prescriptions for Better Home Comfort, Health, and Energy Savings

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Agenda

- DoE building improvement priorities to get most “bang for buck”
- Building as a system & how your building uses energy
- Provide insight into the top 4 common sources of comfort and efficiency problems in older buildings
- How to get Started on the Journey
- $ Incentives to do efficiency improvements work

About Scott Donelson

- **Certified building analyst and envelope professional by the Building Performance Institute (BPI)**

- **Home Energy Consultant**
  - Windows, HVAC systems, remodeling/additions/new construction
- **B.S. -Aerospace Engineering, M.S. -Engineering Mgmt**
- **Originally inspired by having an audit done on my own home in 1995**
  - Genuinely want to help people live comfortably in their homes!
- **President, Home Energy Medics**

About Home Energy Medics

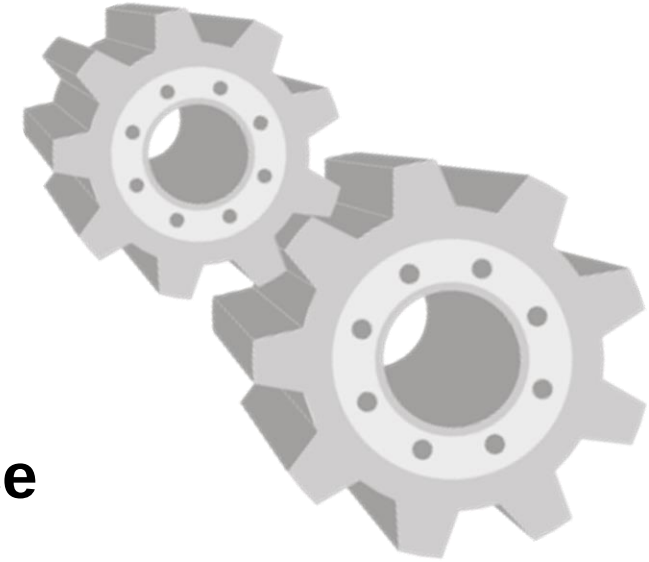
- **BPI gold star accredited contractor**
- **Owned/operated in Arlington since 2009**
  - **Understand the local area homes**
- **Licensed Contractor in VA, MD, and DC**
  - **Specializing in Home Performance: energy audits, insulation, air sealing, HVAC, windows, soundproofing, and more**
- **2023 Sustainability Champion**
  - **Faith Alliance for Climate solutions**
- **2023 Sustainable Business of the Year**
  - **Arlington County Chamber of Commerce**
- **Home Performance with Energy Star Contractor of the Year every year since 2019 (National level award)**

Improvement Priorities (DoE Guidelines)

1. **Air Sealing structure****
2. **Insulation-** to R-49 in attic
3. **Air Sealing Ducts-** Mastic or Aeroseal process
4. **HVAC system upgrade-** Gas to high efficiency heat pump
5. **Water heater upgrade-** heat pump water heater ideal
6. **Window replacement-** compare NFRC tests
7. **Appliance upgrades-** Energy Star qualified
8. **Renewables-** Solar

SAVINGS TYPICALLY 20% OR GREATER for items 1-3 alone & offer HUGE comfort/ efficiency improvements!

BUILDING AS A SYSTEM



- **Building comfort, air quality, moisture, furnace/AC operation, and energy consumption are all interrelated**

- **Insulating and air sealing will reduce building heating and cooling load**
  - Allows for a smaller replacement HVAC system

- **Over-sizing the air conditioner can cause moisture problems (bigger is not always better!)**

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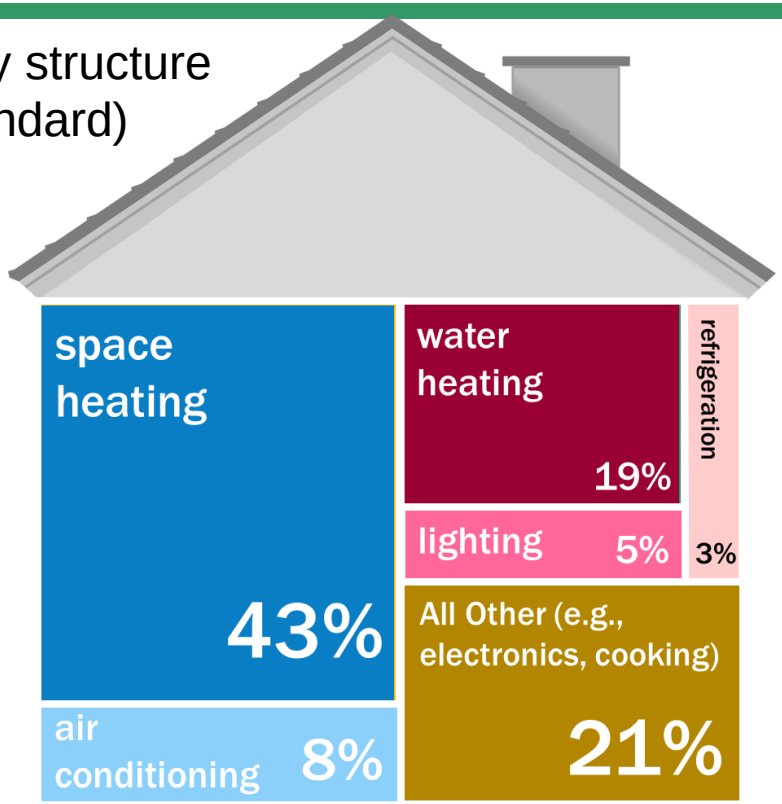
TYPICAL BUILDING ENERGY USE

(for the average leaky structure per building code standard)

- **Heating and cooling breakdown:**
  - **40%** due to air leakage through ducts and structure, remainder is thermal loss through ceilings, walls, etc



Source: U.S. Department of Energy (2020)

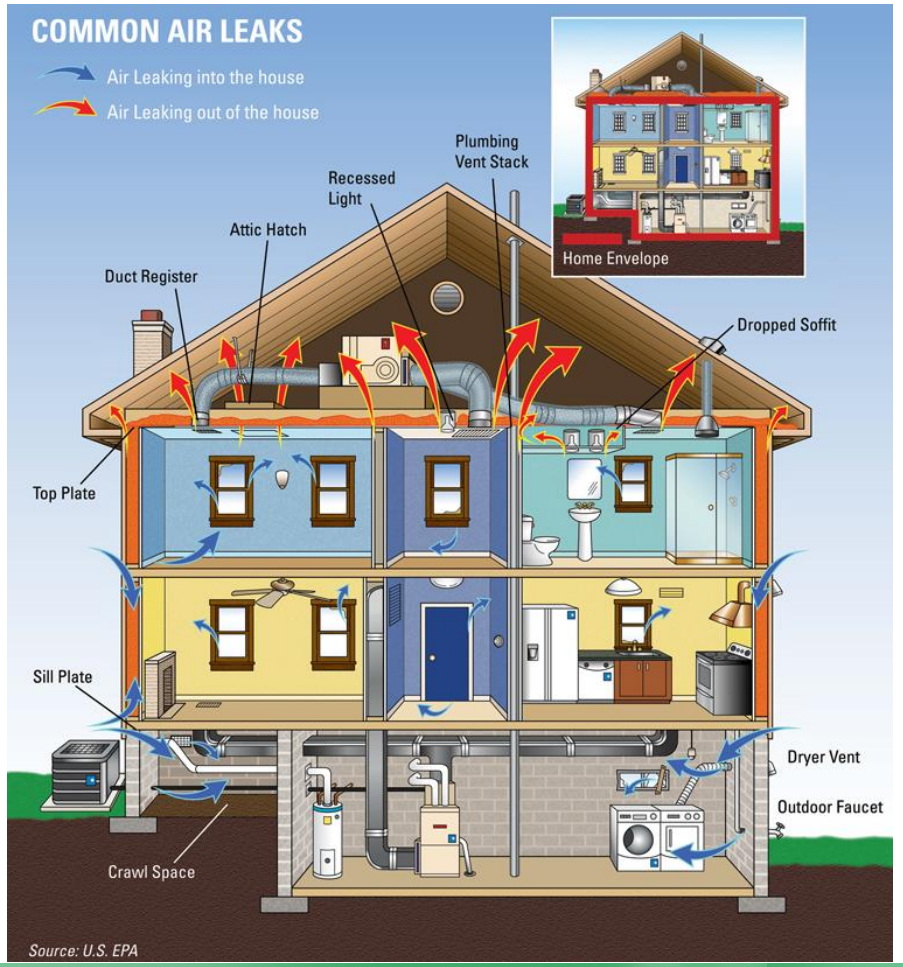
Air leaks cause uncomfortable homes & waste money!

#1 SOURCE OF COMFORT/ EFFICIENCY ISSUES:

Air Leakage

(It is all about the Holes!)

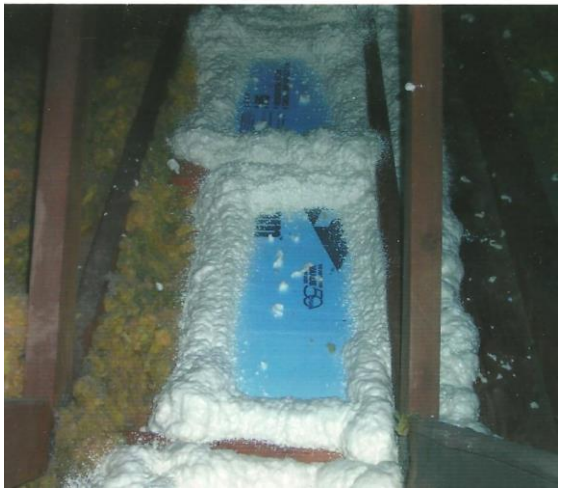
- Most buildings leak **2-5 times** the amount of air they should for healthy air exchange
  - **Air leakage: No. 1 cause of hot and cold spots & energy loss**
- If you had a plumbing leak, would you just continue to let it leak?
- Of course not, so why let air leak out and waste money?



TYPICAL PROBLEMS

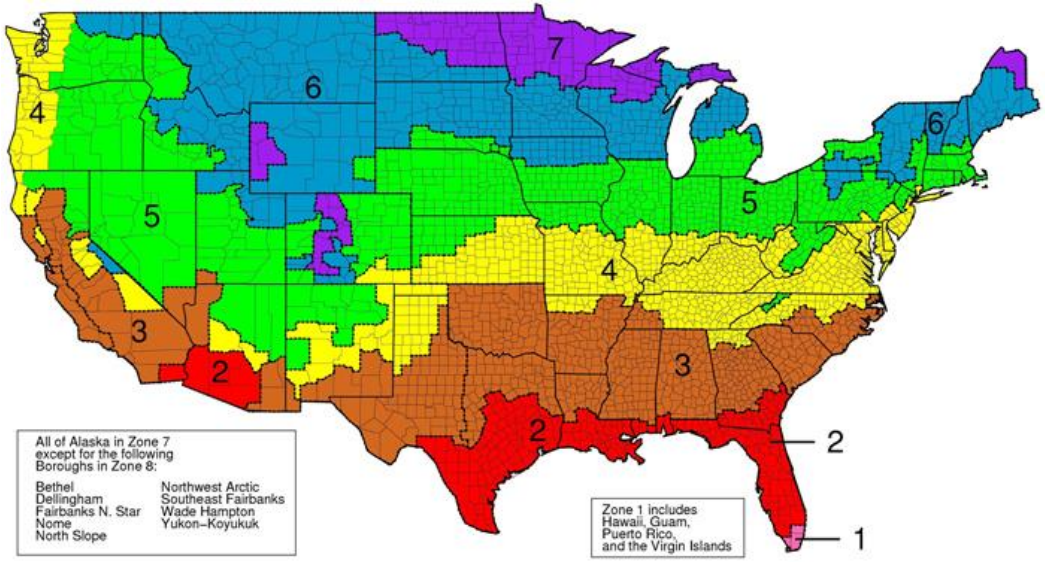
Attic Air Leakage (78% of loss is vertical!)

TYPICAL FIXES
Air Leakage



#2 SOURCE OF COMFORT/ EFFICIENCY ISSUES: Insulation

Zone	Attic	Walls	Floor
4 (VA)	R38 to R60	R13 to R15	R25 to R30

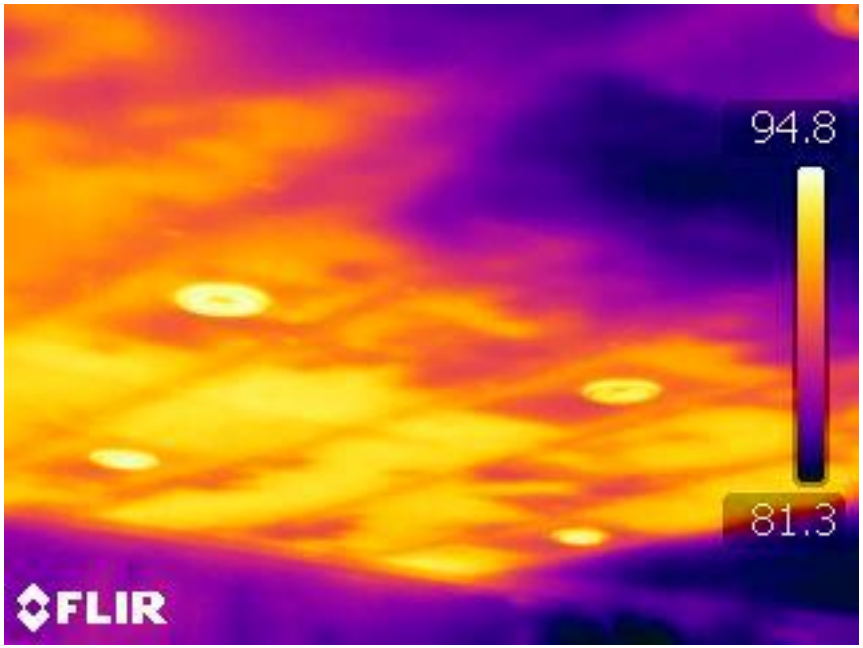


- **Most older bldgs. are only at 50% of required R-Value (or less) <u>BUT</u> adding insulation without air sealing is only approx. 50% effective as the two combined**
  - ***How much insulation is in your congregation's buildings?***
- **Insulation is an air filter <u>NOT</u> an air barrier**

TYPICAL PROBLEMS
Insulation

Insulation levels very low- can see most of joist, should be 4X deeper

Infrared image of a ceiling below an attic- Missing or mis-aligned insulation in attic (Orange=hot)



#3 SOURCE OF COMFORT/ EFFICIENCY ISSUES: HVAC Duct Leakage

- **Ducts typically leak 20% <u>or more</u> if not sealed**
- **Leaks cause lower flow at registers where air needs to go**
  - Leads to cold/hot rooms, system runs more,& increases energy bills
  - Ducts can be sealed internally using the Aeroseal process

#4 SOURCE OF COMFORT/ EFFICIENCY ISSUES: HVAC Replacements

- **Converting gas systems to heat pumps best approach**
  - Most efficient than even the best gas furnaces & environmentally friendly
  - Big gains in technology & can still heat below 32 deg F
    - No more complaints about “blowing cold air”
  - Same equipment used for both heating and cooling
  - Safer- no Carbon Monoxide, less maintenance

Common Misconceptions for Heat Pump Adoption

- **“Heat pumps don’t work well when cold”**
  - Some air-to-air heat pumps heat down to -15 deg F!
- **“We would have to do major electrical upgrades”**
  - Good heat pumps available that do not require backup heat and use existing HVAC power
- **“No options for hydronic heating (radiators)”**
  - Water to water and air to water options
- **“Heat pumps are more expensive”**
  - Comparable to high efficiency gas, but with more tax credits / rebates

New technology much better- delivers much warmer air!

Heat Pump Water Heaters

- **Newer technology**
- **Electric water heater with a heat pump on top**
- **Heat pump uses heat from the air to heat the water**
- **SIGNIFICANTLY (2-3X) more efficient than gas condensing tankless or standard electric**
- **PROS:** more efficient & cheaper to operate, offers dehumidification
- **CONS:**
  - Cools down the room they are in since using the heat from the air
  - need 700 cu ft in mechanical room or should be vented outside the room
  - More cost upfront, but extra efficiency pays for itself & then some!

Heat pump water heaters poised to become the standard!

How Do You Best Start on the Home Efficiency Journey?

- **step 1- A Home Energy Audit, but what is it?**
  - It's an in-home analysis using diagnostic equipment to evaluate the home for comfort issues, energy savings, indoor air quality, and safety issues
  - No two homes the same
  - House as a system approach- can identify interactions
- **Purpose**
  - Find root causes and develop solutions to address cold/hot rooms, reduce energy bills, and fix health and safety issues specific to your home
  - Provide a prioritized list of improvements to follow

HOME ENERGY AUDIT Benefits

Prioritizes improvements- best "bang for the buck"

- **Greater comfort -** no more living with that hot or cold upstairs in the Summer/Winter
- **Lower utility bills -** provides the means to get there
- **Better health -** find sources of smells, Carbon monoxide problems, moisture problems, etc
- **Lower Carbon Footprint**

A home energy audit can identify fixes for 20% + bill savings & to dramatically improve home comfort/health

QUALITIES OF A GOOD AUDIT (not all created equal!)

- **Auditor Building Performance Institute(BPI) certified both as building analyst and envelope professional**
  - Ask or check with BPI
- **Includes combustion safety testing, IR imagery, bill analysis, and other mechanical systems assessment**
  - Get a written list of the services provided - can't just compare by price
- **Includes comprehensive report tailored to home with pictures & prioritized list of recommendations**
  - To include blower door, combustion safety, IR camera, and other assessments
  - Ask for a report example

Inflation Reduction Act Tax Credits

(maximum amounts per year)

1. **Air sealing and Insulation- $1200**
2. **Heat pump water heaters- $2000**
3. **HVAC Heat pump switch from gas or upgrade - $2000**
4. **HVAC gas high efficiency system- $600**
5. **Electric Panel upgrade for electric HVAC conversions: $600**
6. **Window replacements, $600**
7. **Energy audits- $150**
8. **Others Available/ More details:**

https://www.energystar.gov/about/federal_tax_credits/non_business_energy_property_tax_credits

Dominion Electric Customer Option

Home Energy Evaluation Program

- **Geared towards homes with heat pumps**
- **Heat pump upgrades, up to $312**
- **Heat pump water heater upgrades, $234**
- **Some Light bulbs**
- **Insulation and air sealing- $1000s (no limit)**
  - Depends on attic size, insulation depth added, air leakage reduction
- **Must have an energy audit done by a participating contractor to get $, they do the paperwork**
  - https://www.domsavings.com/home-program/home-energy-evaluation

CONCLUSION

- **Air Leakage is the number one cause of comfort/efficiency problems followed by low insulation, duct leakage, and HVAC upgrades**
- **Heat pumps are the way to go when replacing aging HVAC systems**
  - Do as planned replacements, not emergency ones
- **Start with an energy audit**
  - Gives the prioritized roadmap to start making improvements

Making some basic insulation and air sealing improvements can dramatically imrpvoed comfort & save 20% or more on energy bills

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BACKUP/ALTERNATE SLIDES

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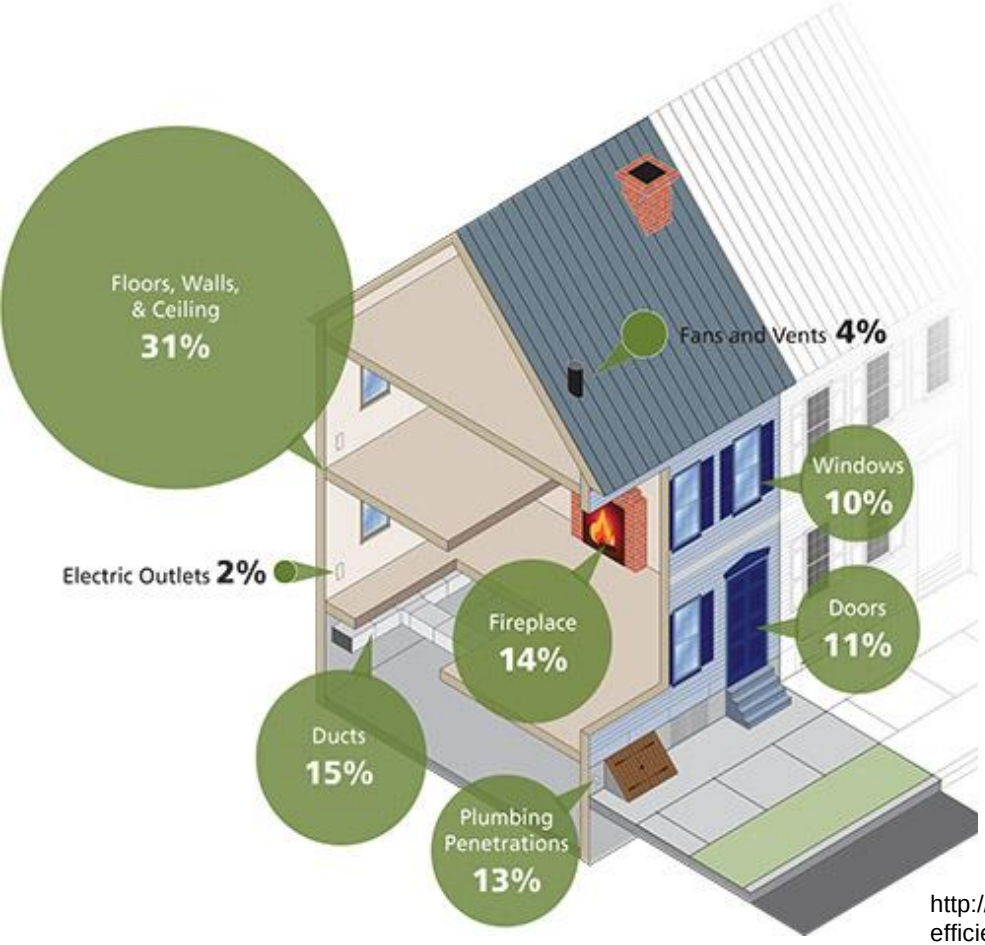
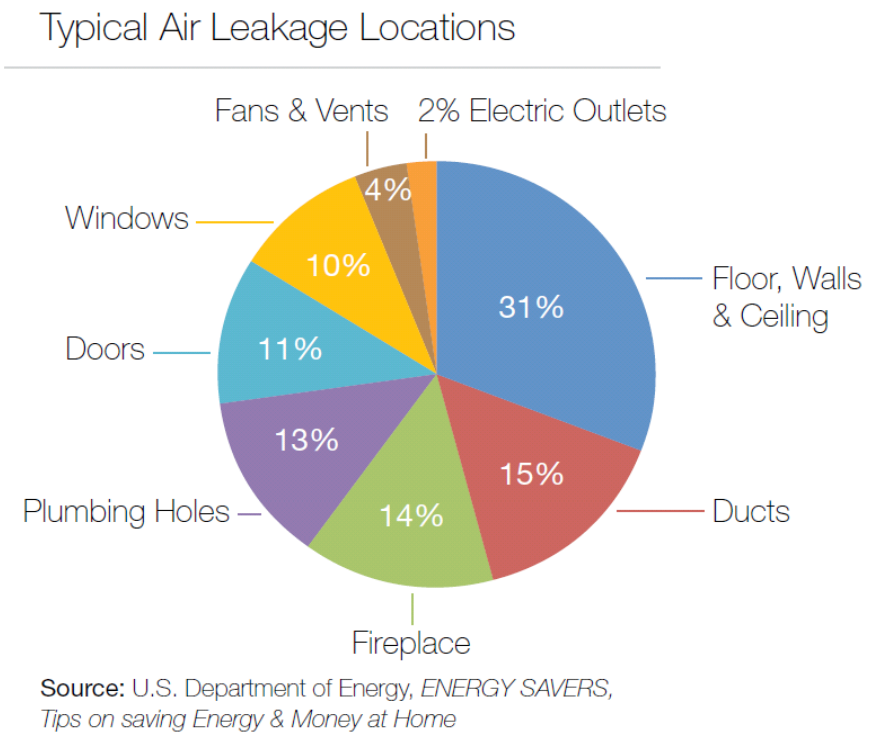
Where does the Air Leakage Occur?





http://www2.cr.nps.gov/tps/sustainability/energy-efficiency/weatherization/air-infiltration.htm

www.EnergyEfficiencyArkansas.org

TYPICAL FIXES
Insulation

BEFORE

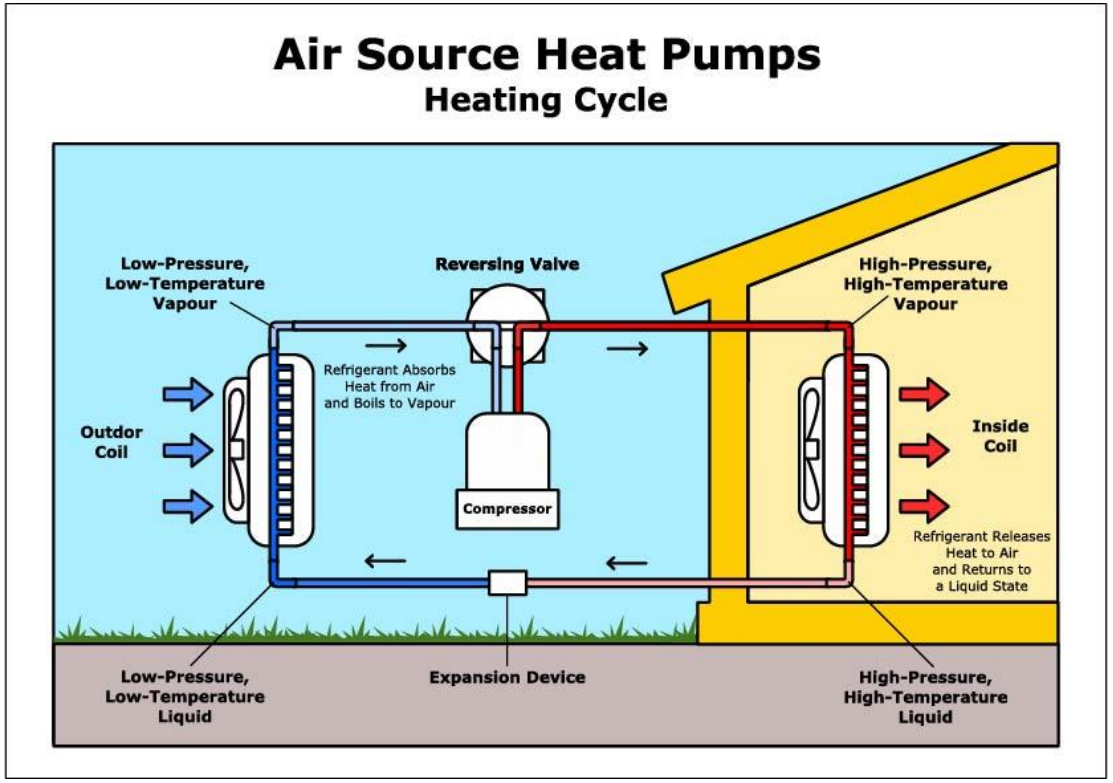
Skylight shaft insulation - needs refit & convective air barrier wrap to be effective

No wall insulation or air barrier, little floor insulation when boards pulled

AFTER

Heat Pump 101

- **Heat pumps MOVE heat between indoors and outdoors, they do NOT create heat by burning a fossil fuel**
  - Done by compressing and expanding refrigerant
  - Heat is moved outside to inside in Winter
  - Heat is moved inside to outside in Summer



Moving heat WAY more efficient than burning to create heat

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Heat Pump 101 Additional Info/ Types

- **This Old House Videos**
  - **Basics on heat pump operation**
    - How a heat pump works, Richard: https://youtu.be/-vU9x3dFMrU?si=mjBzEqyOK6nZiTKP
  - **Different types (water to water, water to air, air to air, air to water)**
    - Heat Pump Overview – multiple types, Ross: https://youtu.be/1sxJY8qA4EM?si=YYXyzzIDZzcJYY7p
- **Air to Air heat pumps most common and least expensive**
- **Water to water or water to air typically geothermal heat source**

Regardless of heat source- radiators, force air, etc., and commercial or residential system, there are options available for your home

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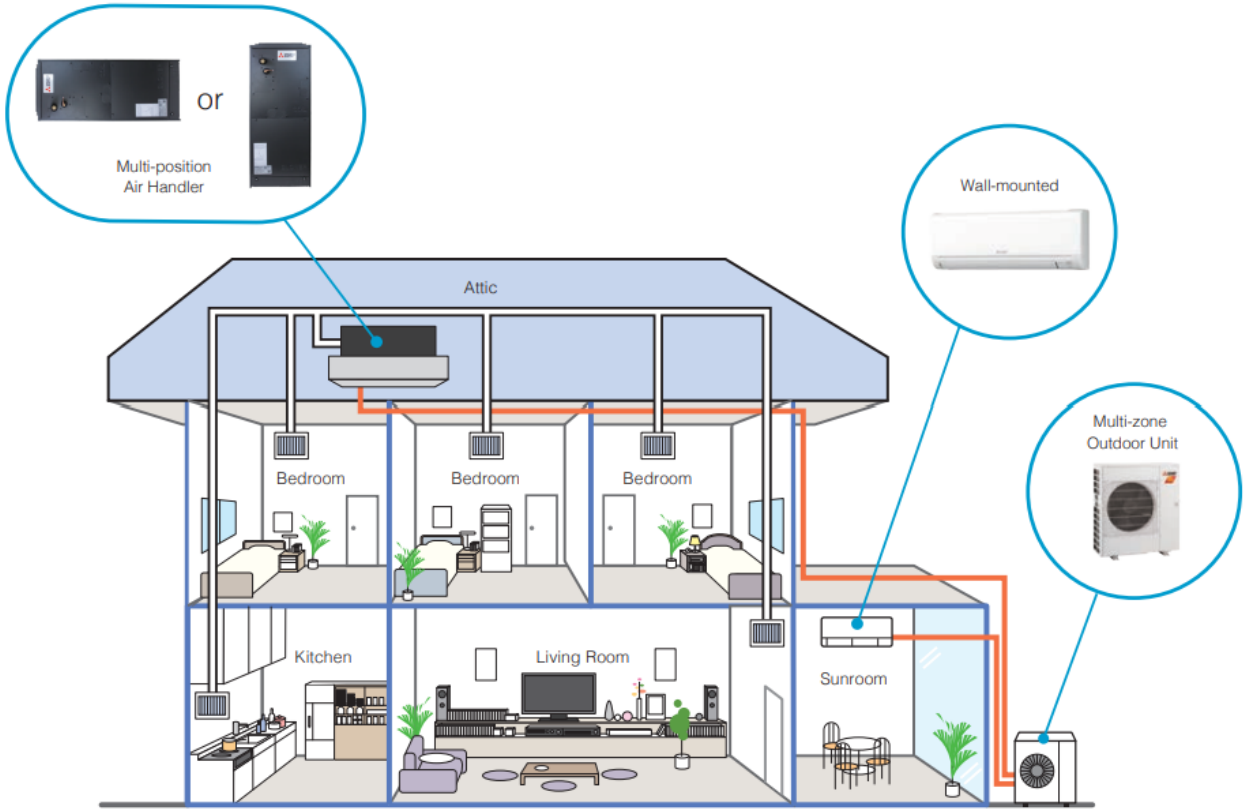
Distribution- Options Huge for Retrofits!

- Ducted air handler
- Ducted or ductless mini-split heads
- Hydronic (radiators)



HOME ENERGY AUDIT Process

1. Interior and exterior Inspection
2. Combustion safety testing- <u>most important</u>
3. HVAC/water heater efficiency & performance analysis
4. Blower door test
5. Infrared camera analysis
6. Basic duct leakage assessment

A home energy audit can identify fixes for 20% + bill savings & to dramatically improve home comfort/health

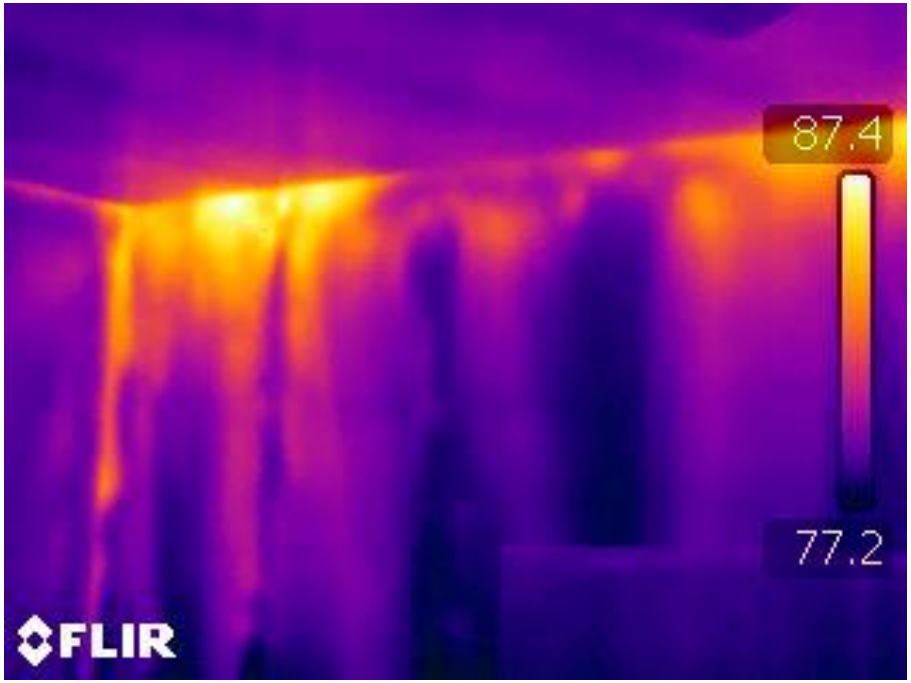
AUDIT TOOLS
Blower door & combustion safety

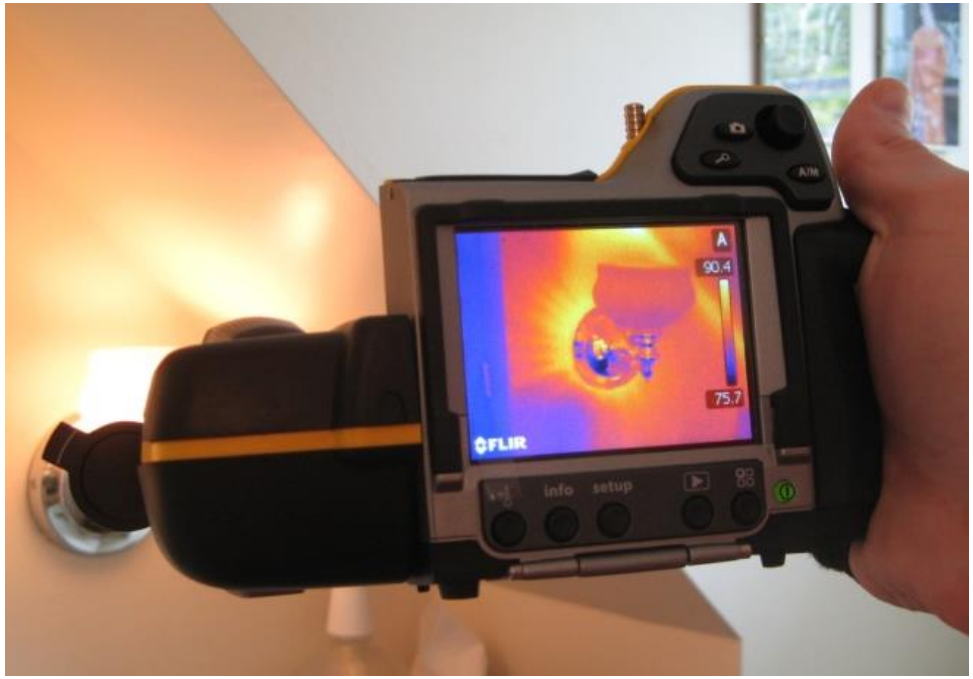
- **Combustion analyzer-** CO, efficiency
- **Gas leak detector**
- **Manometer**- draft pressure

- **Blower door**- measures the air leakage throughout the home

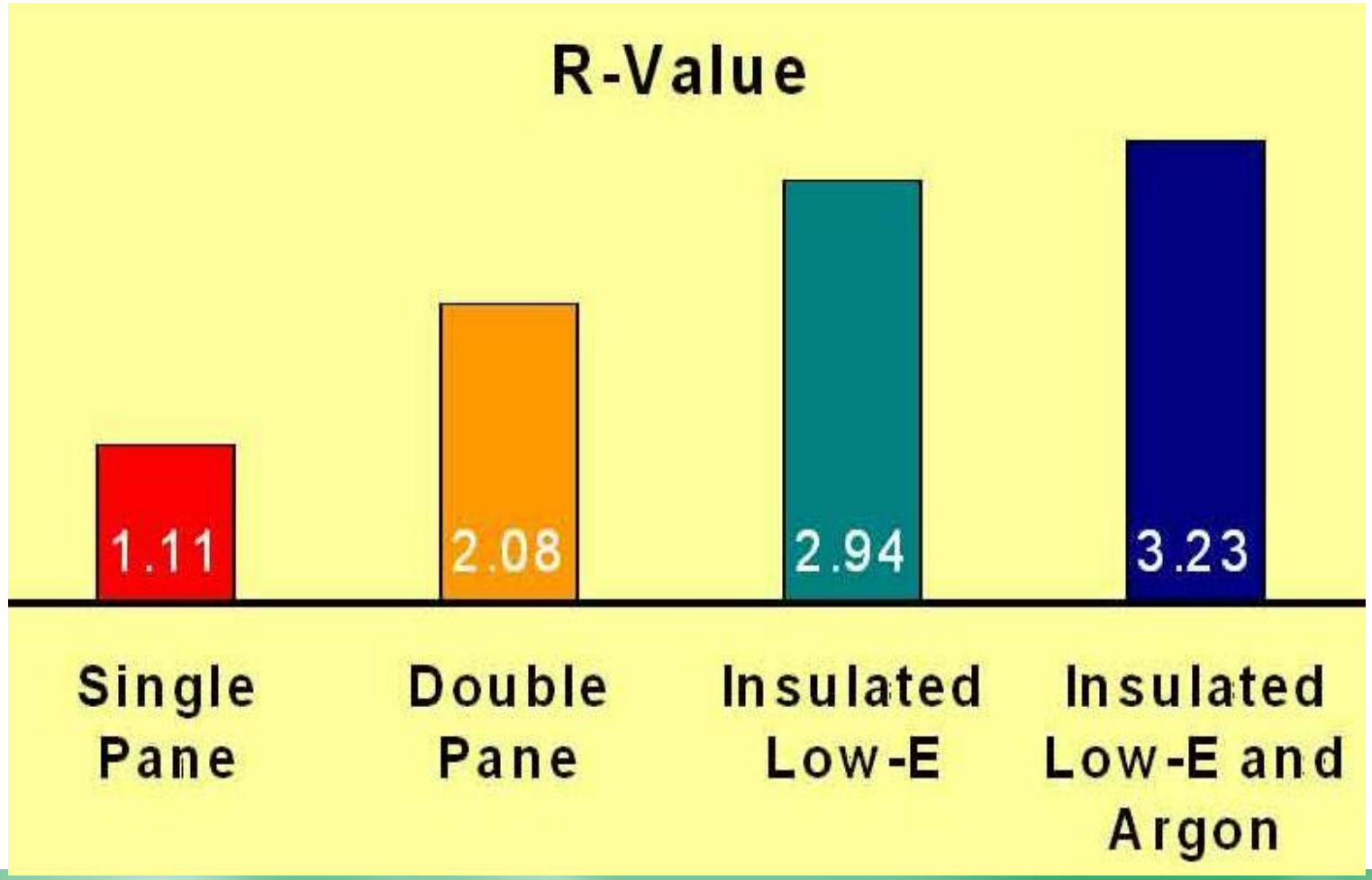
AUDIT TOOLS
Infrared (IR) Camera

- **Can see air leakage and problems behind walls**
- **Can identify moisture problems**





Is Window Replacement Cost Effective Insulation?



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