WEATHERIZATION PLUS HEALTH

Keep It Dry and Ventilated

Making connections
for healthier, more
energy efficient homes

U.S. DEPARTMENT OF ENERGY

NASCSP

Steps to Healthier Homes

- Keep It:

Dry	Clean
Pest-Free	**Ventilated**
Safe	Contaminant-Free
Maintained	

IOM Report Mold & Moisture Related Health Effects

- Upper respiratory tract symptoms
- Coughing
- Wheezing
- Asthma symptoms
- Hypersensitivity pneumonitis

Dampness and Asthma

Health Outcome	Estimated % Increase in Damp Homes
Upper respiratory tract symptoms	52%
Cough	50%
Wheeze	44%
Current asthma	50%
Ever-diagnosed asthma	33%

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Asthma Triggers

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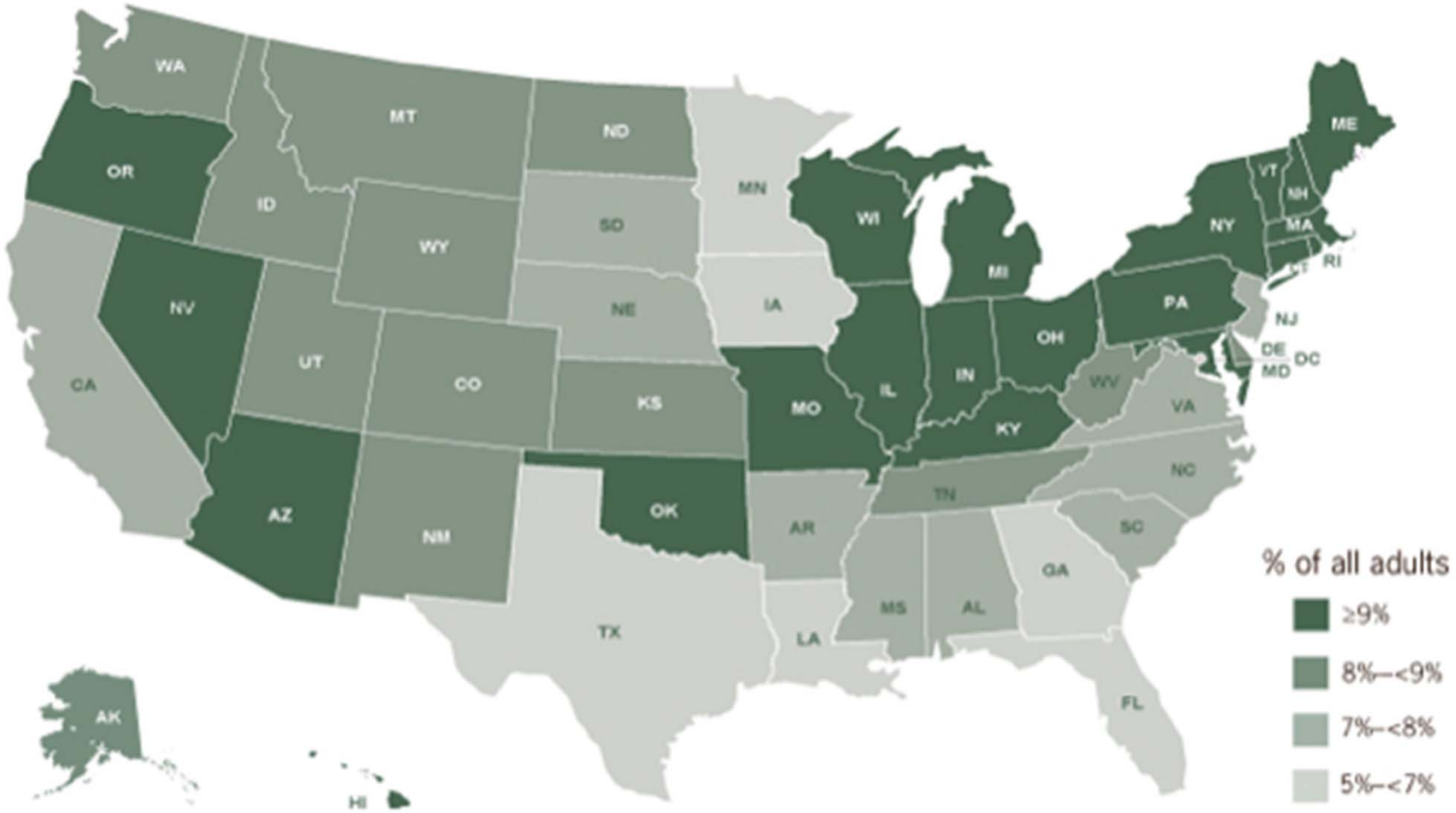
Adults with asthma in the US, 2009

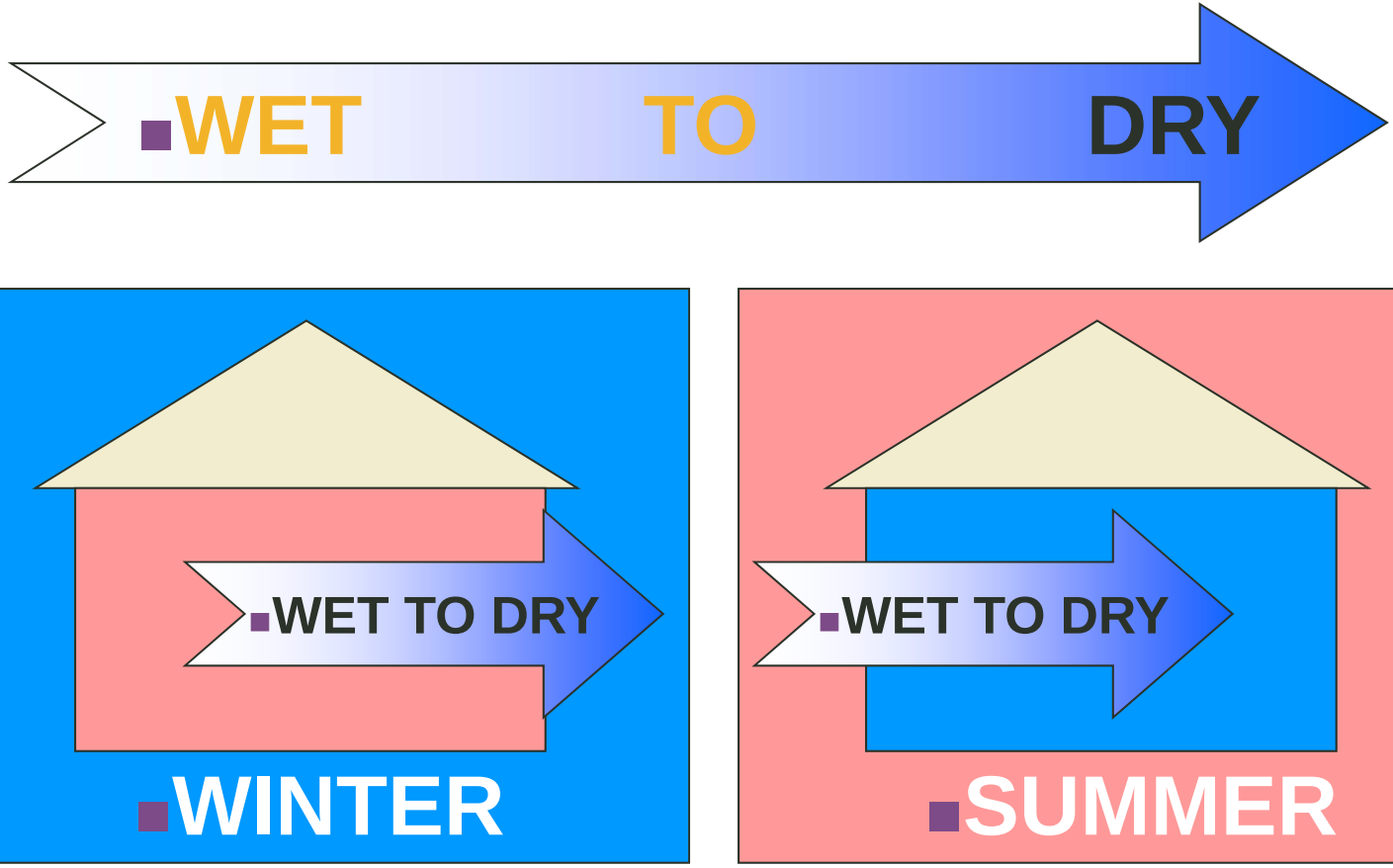


SOURCE: Behavioral Risk Factor Surveillance System, 2009

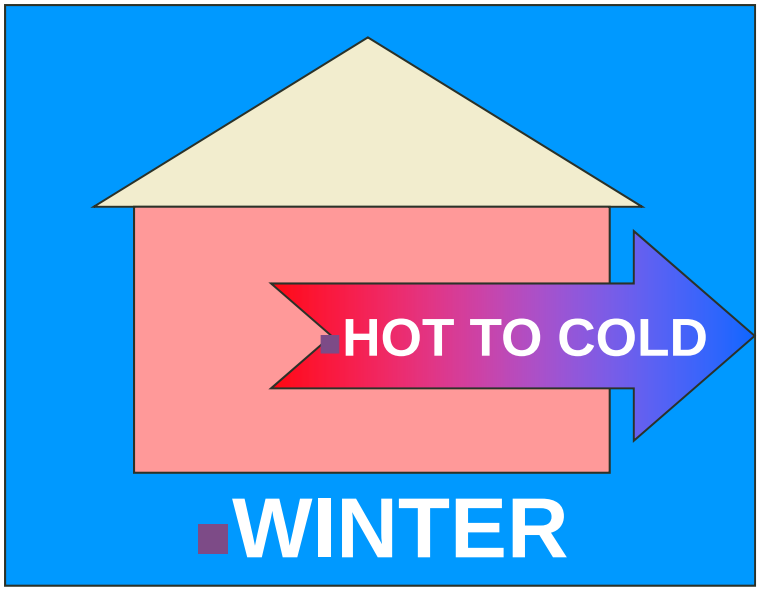
Moisture Sources

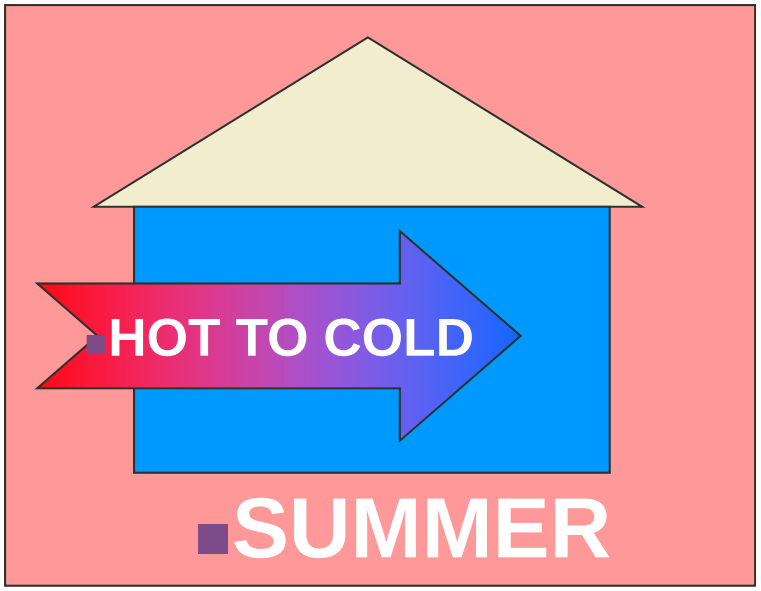
- Poorly managed rainwater/groundwater
  - Poor roof, wall, window and foundation drainage
  - Defects in rain barriers
- Plumbing leaks
- Household sources & condensation
  - Surfaces chilled by mechanical equipment, earth contact, outdoor air contact
  - Unvented space heaters
  - Showers, cooking, breathing
- Air transported moisture
  - Crawl space moisture or exterior humid air
- Construction moisture

Moisture Moves…

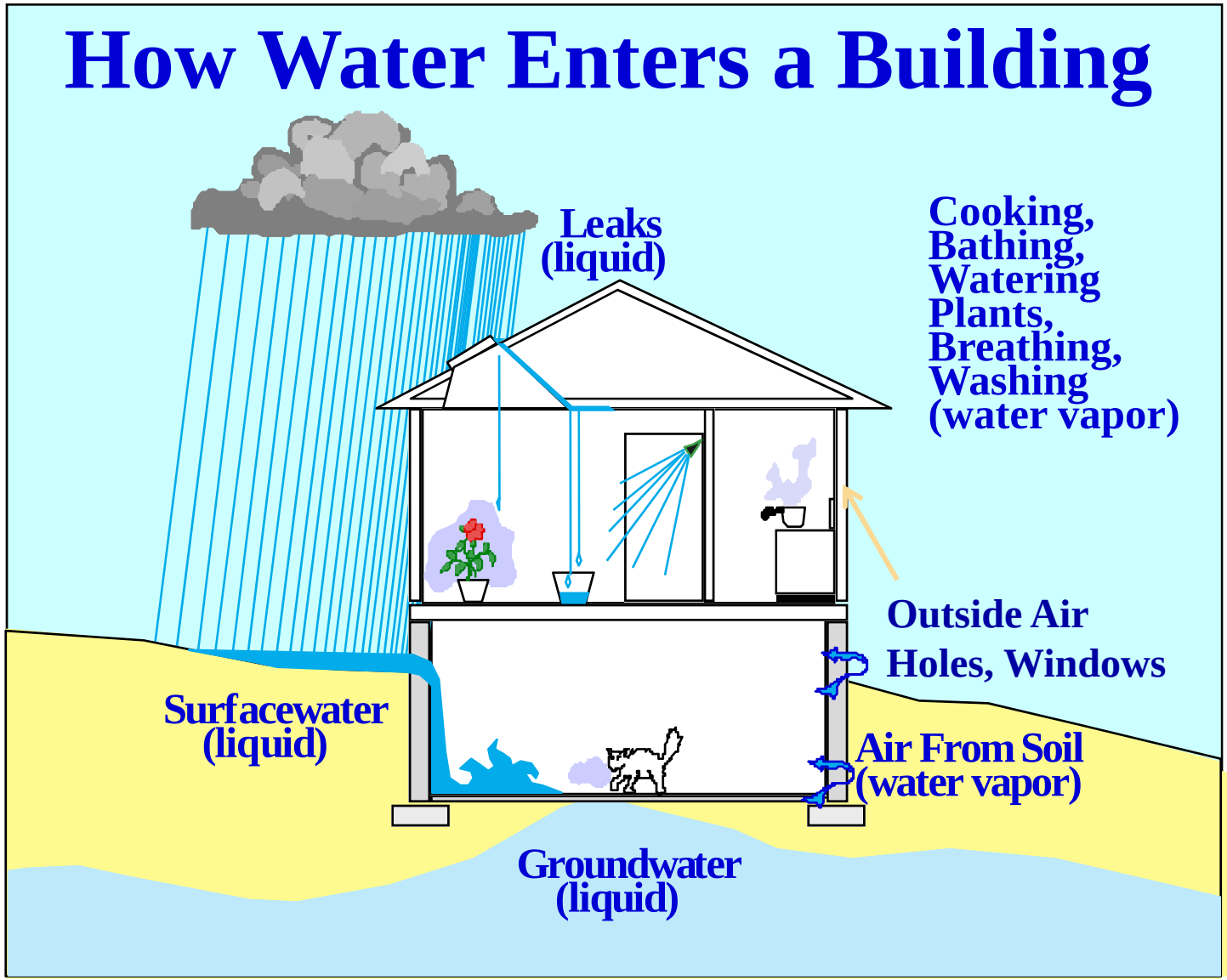


Moisture Moves…





How Water Enters a Building



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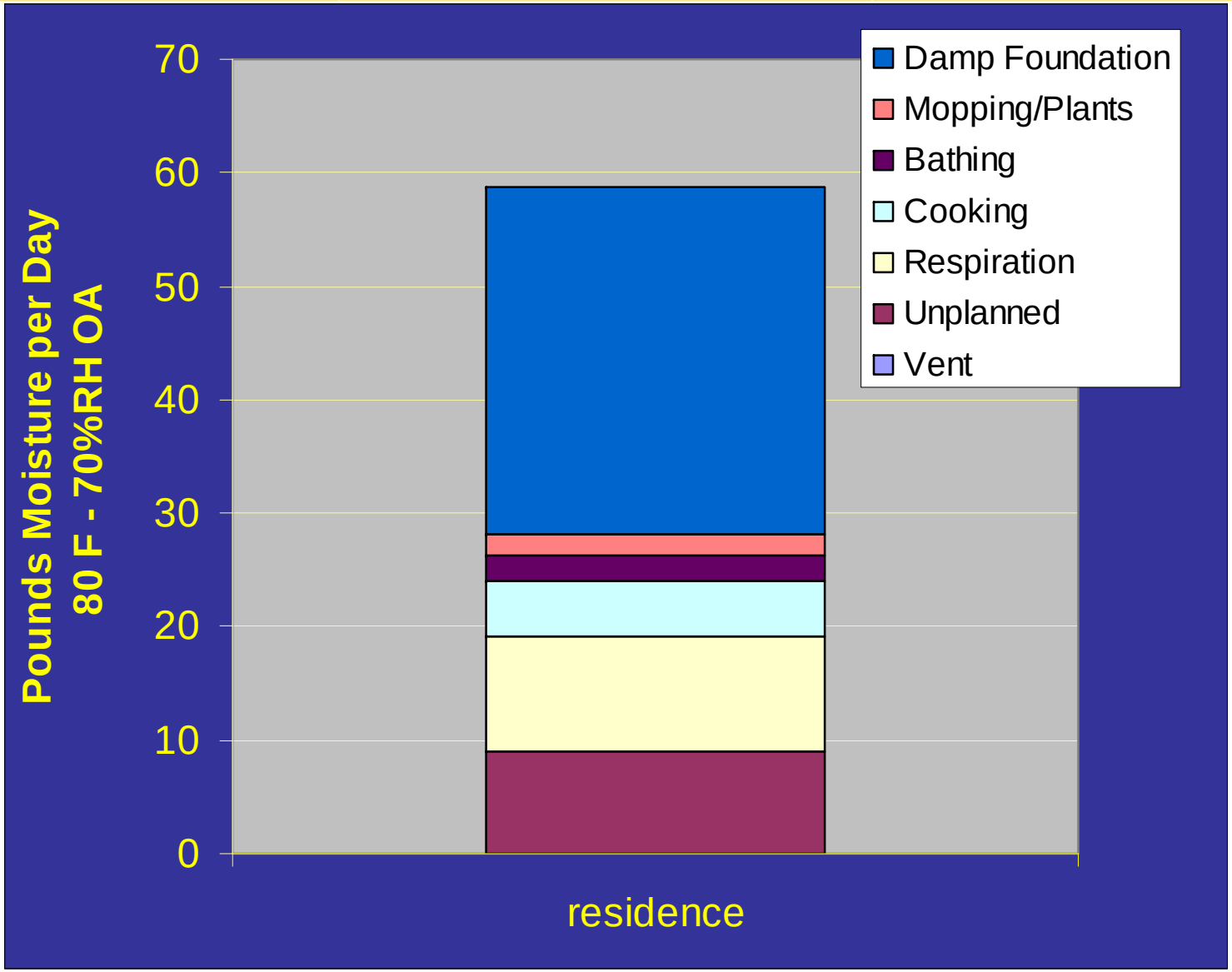
Windows Leak

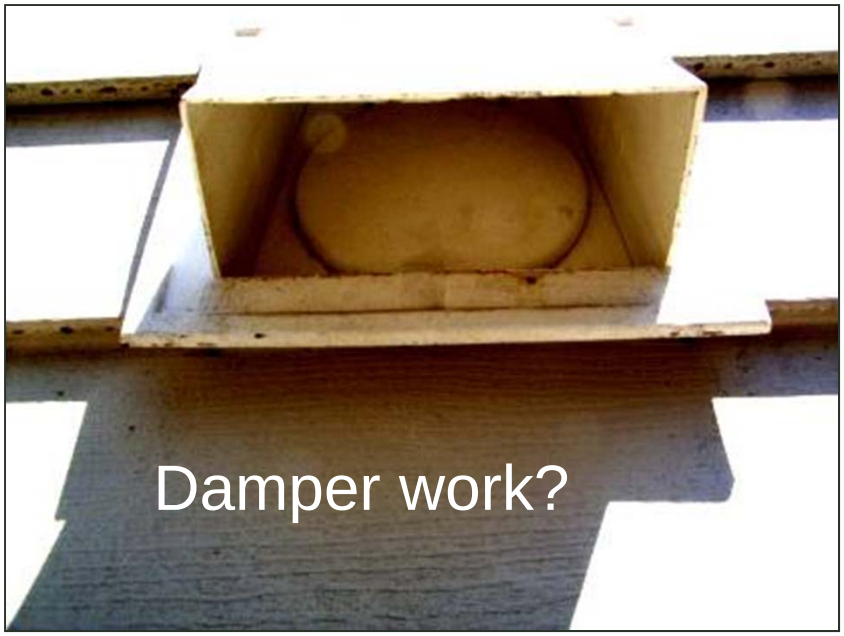
Plumbing Leaks


Drain pan in the event of heater leak

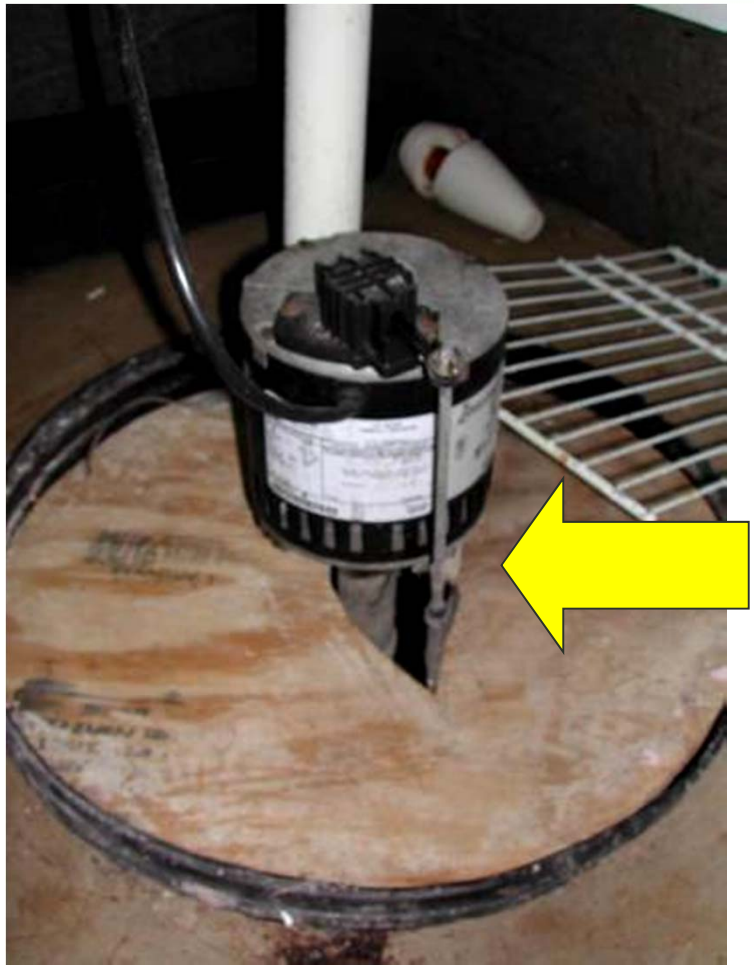

Pounds Moisture per Day
80 F - 70%RH OA
70
60
50
40
30
20
10
0
residence
Damp Foundation
Mopping/Plants
Bathing
Cooking
Respiration
Unplanned
Vent


02/04/2008


Ducted ok?


Damper work?

Unsealable recessed light allows warm, moist air into the unheated attic.



Failed drainage systems

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Mold in the air conditioner?

Bad Crawlspace

Crawlspaces may contain mold, pests, pesticides, asbestos, lead paint and sewer gas. An apparently dry crawlspace can add excessive water vapor to a house.

Good Sealed Crawlspace

Moisture meters are useful in determining whether a material is wet or not and tracing the source of problem water.

Address Interior Moisture First

- Moisture where you don't want to insulate – attic sheathing
- Wet walls
- Etc

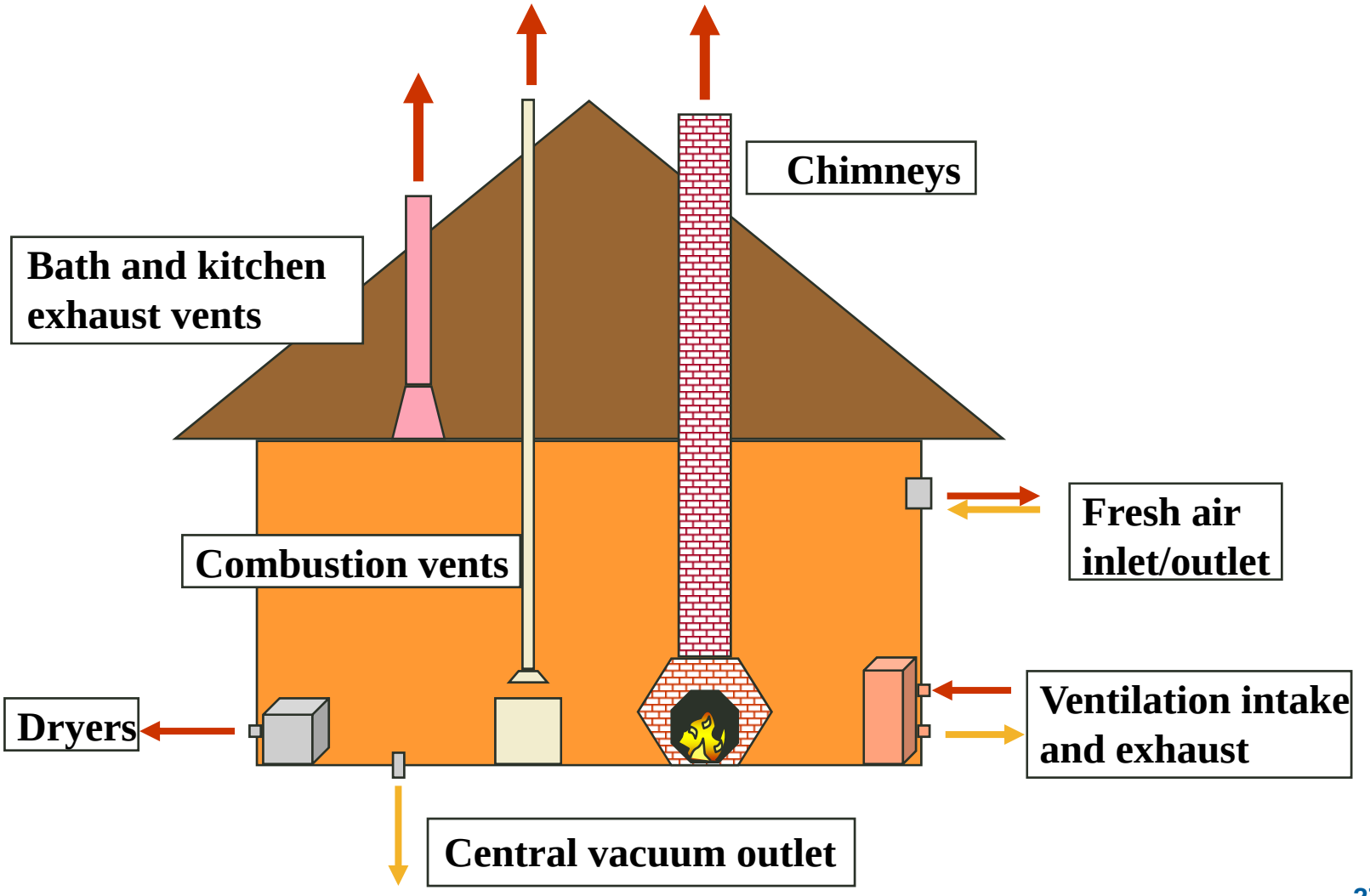
Moisture Assessment

- Wet spots/water – inside and outside
- Mold/stains/rot – inside & outside
- Condensation/humidity – attic, living space, windows, basement/crawl space
  - Warning Signs: greater than 65% Rh in when AC on or greater 55% Rh inside when temp <45 degrees
- Always ask: what's the moisture source and likely fix

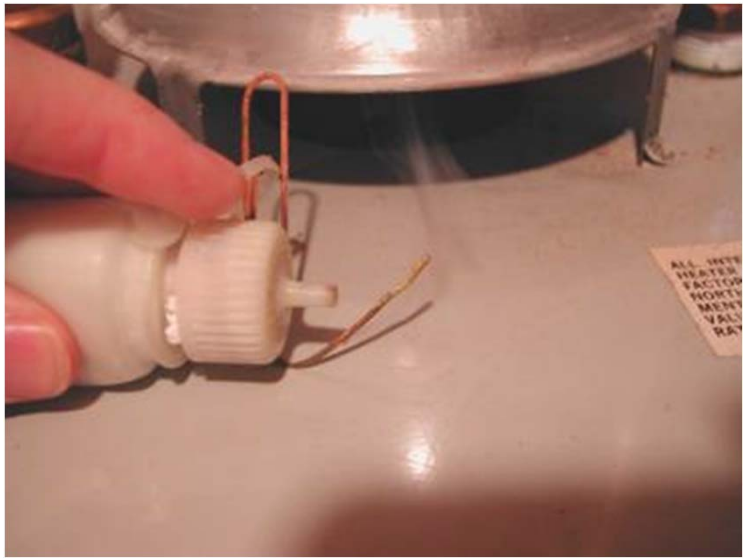
WAP Eligible Moisture Expenses

- Limited repairs for water damage & mold creating conditions, when necessary to ensure the long term durability of the measures (e.g., roof repair, downspout, dryer/bath ventilation)
- **Defer**: Severe mold and moisture issues
- **No**: Mold testing not funded.

Ventilate


Chimneys
Bath and kitchen exhaust vents
Fresh air inlet/outlet
Combustion vents
Dryers
Ventilation intake and exhaust
Central vacuum outlet

Ventilate Combustion



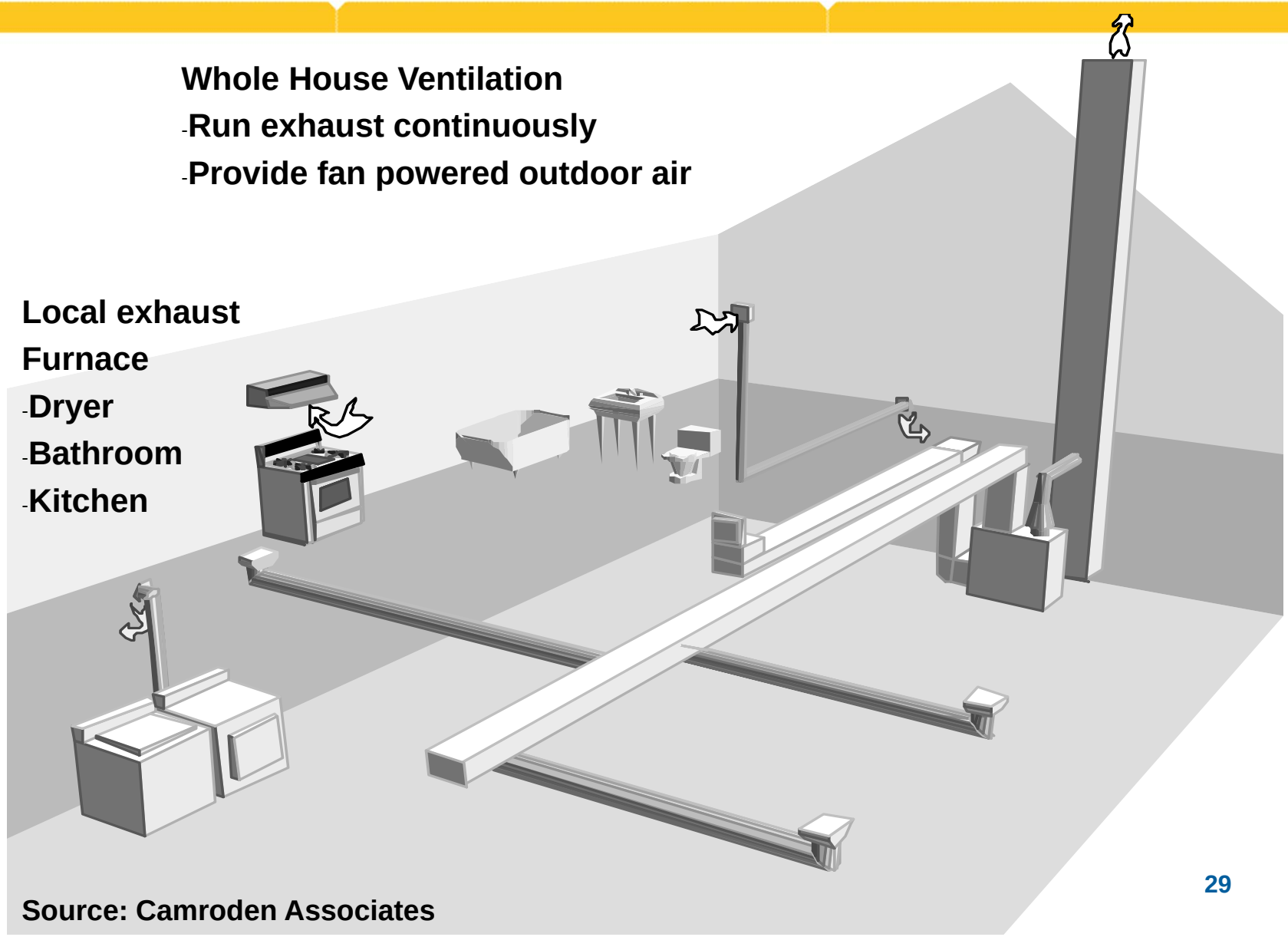
Whole House Ventilation

- **Run exhaust continuously**
- **Provide fan powered outdoor air**

Local exhaust

Furnace

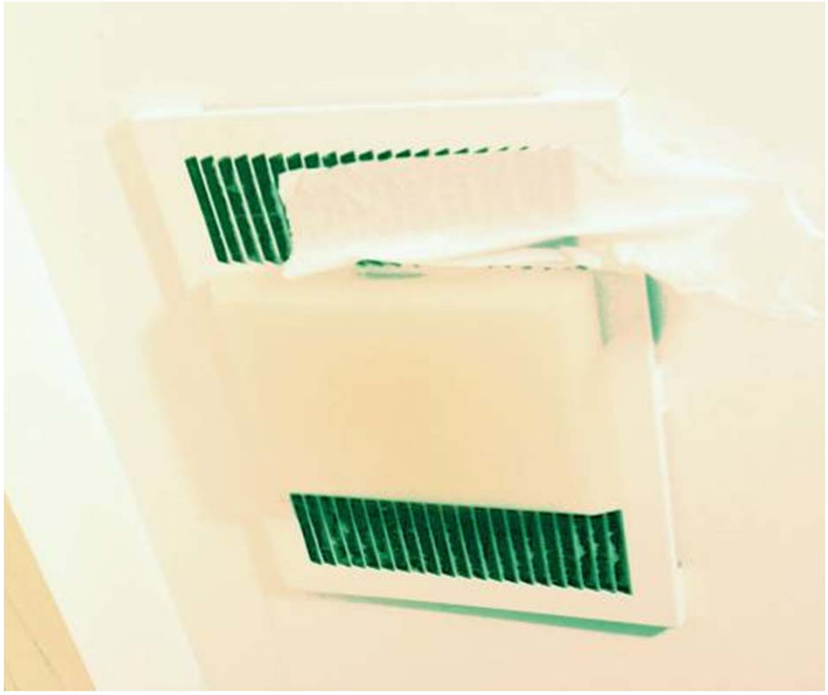
- **Dryer**
- **Bathroom**
- **Kitchen**



Source: Camroden Associates

Test Exhaust Fans - Do They Work?

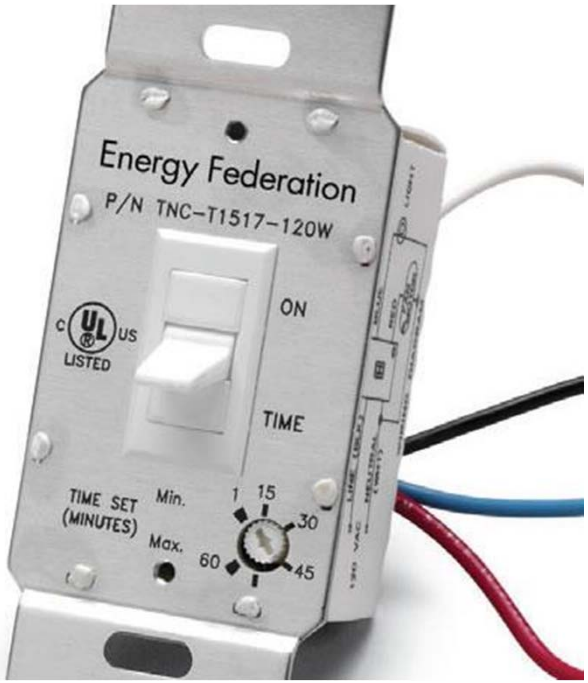
The Charmin Method



Fan Flow Meter

A fan flow meter connected to a manometer measures fan flow. Needed for ASHRAE 62.2 calculations and to verify CFM of newly installed fans.

Energy Star Fans & Timers



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Filter Cooled or Heated Air

Poorly sealed filter access panel

MERV

Minimum Efficiency Rating Value (MERV)

ASHRAE Standard 52.2 – Efficiency in collecting very small particles

MERV Ratings

MERV	PARTICLE SIZE (μm)	TYPICAL CONTROLLED CONTAMINANT
1 – 4	>10.0	Pollen, sanding dust, textile and carpet fibers
5 – 8	3.0 – 10.0	Mold, spores, hair spray,cement dust
9 – 12	1.0 – 3.0	Legionella, lead dust, welding fumes
13 – 16	0.3 – 1.0	Bacteria, most tobacco smoke, insecticide dust, copier toner
17 - 20	≤ 0.3	Virus, combustion particles, radon progeny

Leaky Homes May NOT Ventilate Right

Single-story 1500 ft² house

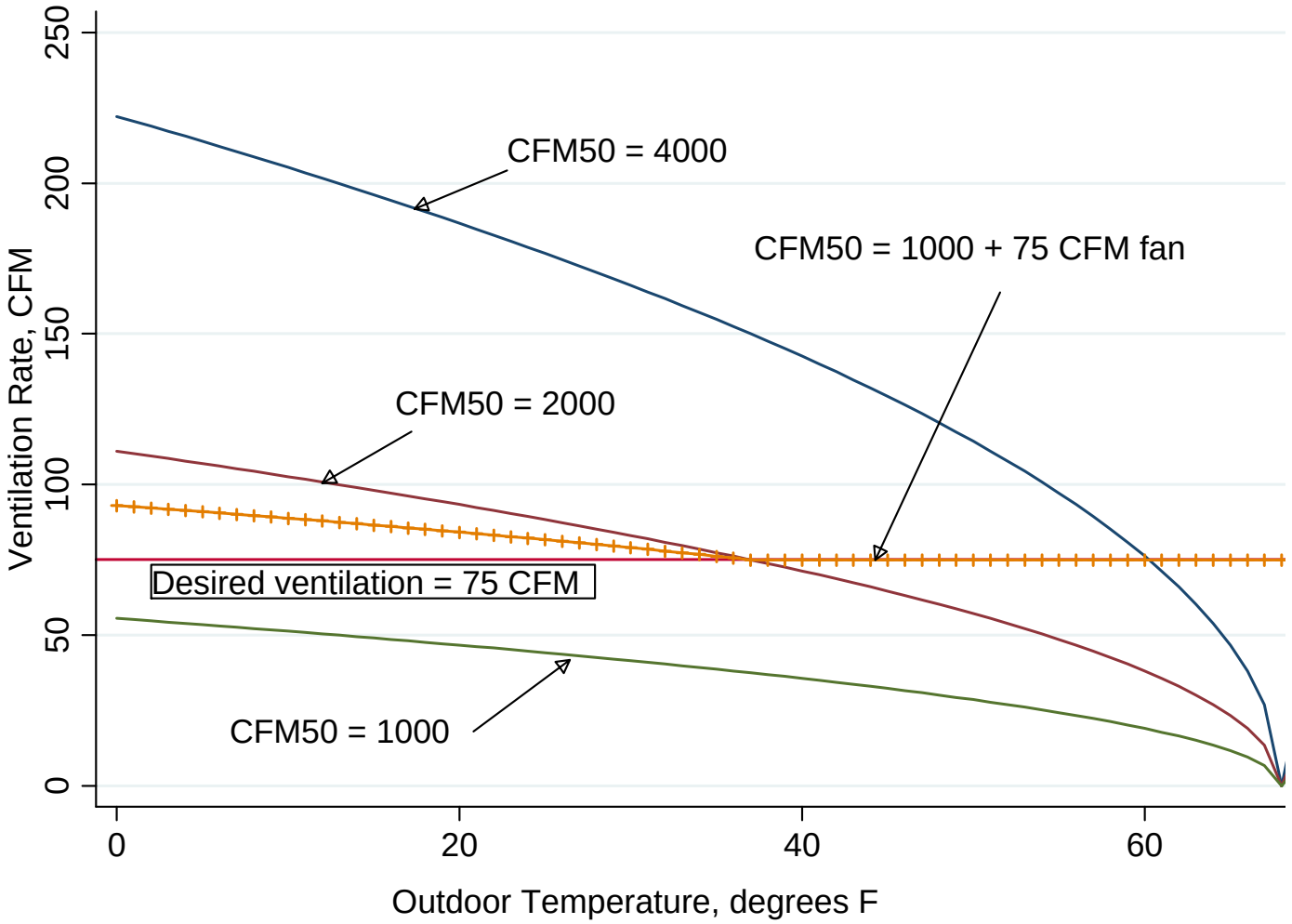


Chart courtesy of Paul Francisco

ASHRAE 62.2 Point Source

- Point source ventilation
  - Bath:
    - 50 cfm on demand OR
    - 20 cfm continuous
  - Kitchen
    - 100 CFM on-demand OR
    - 5 ACH, based on kitchen volume. ⌴ 12’ x 14’ x 7.5’ kitchen requires 105 CFM.

62.2 Whole House Ventilation New Homes

Floor Area (ft^2)	BEDROOMS				
	0 - 1	2 - 3	4 - 5	6 - 7	>7
< 1500	30	**45**	60	75	90
1501 – 3000	45	60	75	90	105
3001 – 4500	60	75	90	105	120
4501 – 6000	75	90	105	120	135
6001 – 7500	90	105	120	135	150
> 7500	105	120	135	150	165

Courtesy of DOE WAP & Rick Karg of R.J. Karg, Associates

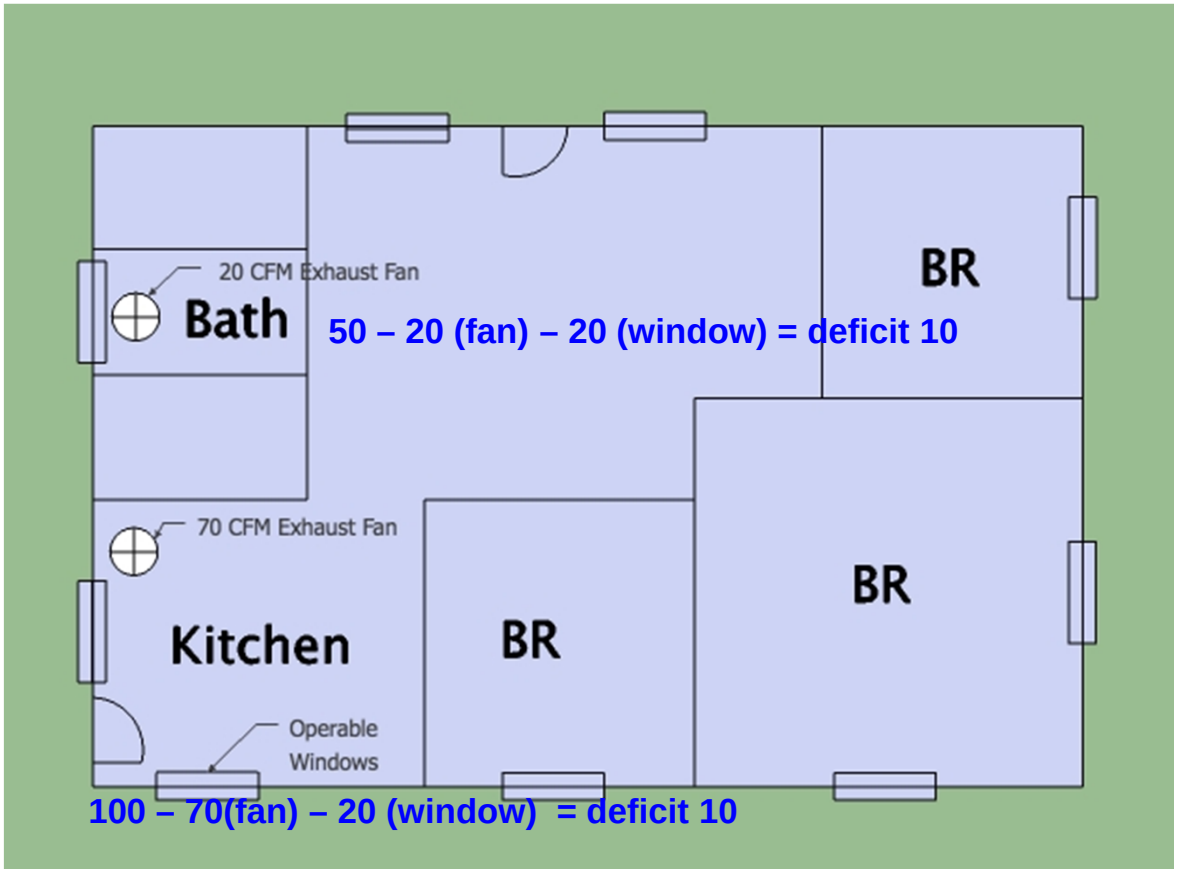
Alternative Compliance Existing Bldgs

$$CFM_{fan} = 0.01A_{floor} + 7.5(Number_{bedroom} + 1) +$$
(spot ventilation deficit) - (Infiltration credit)

3 Key Steps:

- Determine whole house continuous requirements = 0.01A + 7.5 * # occupants
- Calculate the spot ventilation deficit from require bath & kitchen cfm/4 (measure fan flows)
- Calculate the infiltration credit (post WAP blower door cfm 50 estimate)

Sample 62.2 Compliance



- 1500 ft2, 1 story
- 3 bedrooms, 4 occupants
- Norfolk, VA
- Bath 20 CFM
- Kitchen 70 CFM
- 1250 CFM_{50} Post Work

Needs 38 CFM

Solutions: ERV; added bath fan CFM

Source: US Dept of Energy WAP Standardized Training Curriculum

62.2 Compliance Samples

- Original home, but 2000 ft^2 instead of 1500, in Portland, ME? – needs 46 CFM, Solutions: increase bath fan CFM & possible added fan in hallway; HRV
- Wisconsin study showed 62.2 compliance required added ventilation in about 3/4 of weatherized homes.

Which system is right?

- Heating areas - exhaust only.
- Cooling areas supply only.
- Intermediate areas – where heating and cooling seasons are both significant – require balanced systems.
- A balanced system is technically acceptable – it will work - anywhere.

Cost-effectiveness

Exhaust only vs. HRV in a cold climate.

Annualized cost = Installed cost/lifetime + annual operational costs + annual heating (or cooling) penalty.

Fan Type	Installed Cost	Lifetime (yrs)	Operational cost/yr	Heating penalty/yr [1]	Total annualized cost
Exhaust only, 20 CFM	$400	10	$30	$1,123	$1,192
HRV, 20 CFM	$800	10	$200	$550	$830

Based on oil @ $4/gal burned at 80% efficiency in 6500 HDD climate.

HRV assumed to reduce heat lost from exhausted air by 50%.

Source: US Dept of Energy WAP Standardized Training Curriculum

62.2 Compliance Summary

- The natural ventilation calculation we've used for years is flawed when dealing with weatherized homes.
- Re assess your building tightness limit now that you need to add ventilation.
- ASHRAE 62.2 is a performance standard – fan flow must be measured.
- The math to compute the required fan flow can seem complicated, but is really a series of simple steps.
- Computer programs are available – some are free.
- The chosen ventilation method has to match local environmental conditions.

Source: DOE WAP

Ventilation Assessment

- Is existing ventilation working:
  - Bath fans exterior exhaust? Flow rates?
  - Kitchen fans exterior exhaust? Flow rates?
  - Dryer exterior exhaust?
  - Filter ratings
  - Whole house ventilation
- Does home meet ASHRAE 62.2 (existing buildings)?
- Seal between attached garage & home

WAP Eligible Ventilation Expenses

- Meet ASHRAE 62.2
- Specific actions under 62.2
  - Bath fans
  - Dryer vents
  - Whole house ventilation
  - Seal connections to attached garage
- Certain paradise climates are exempt

EPA Protocols for Energy Upgrades

- Minimum Actions?
- Added Opportunities?