

A Conversation About
Home Performance

by

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From the City of Foster City and ESTF's Creating Energy Smart Homes on 8/11/10

“Sick” Home Symptoms

Comfort

Too cold in winter

Too hot in summer

Health

Allergies

Mold or Moisture

Efficiency

High energy bills

Carbon footprint

Interrelated

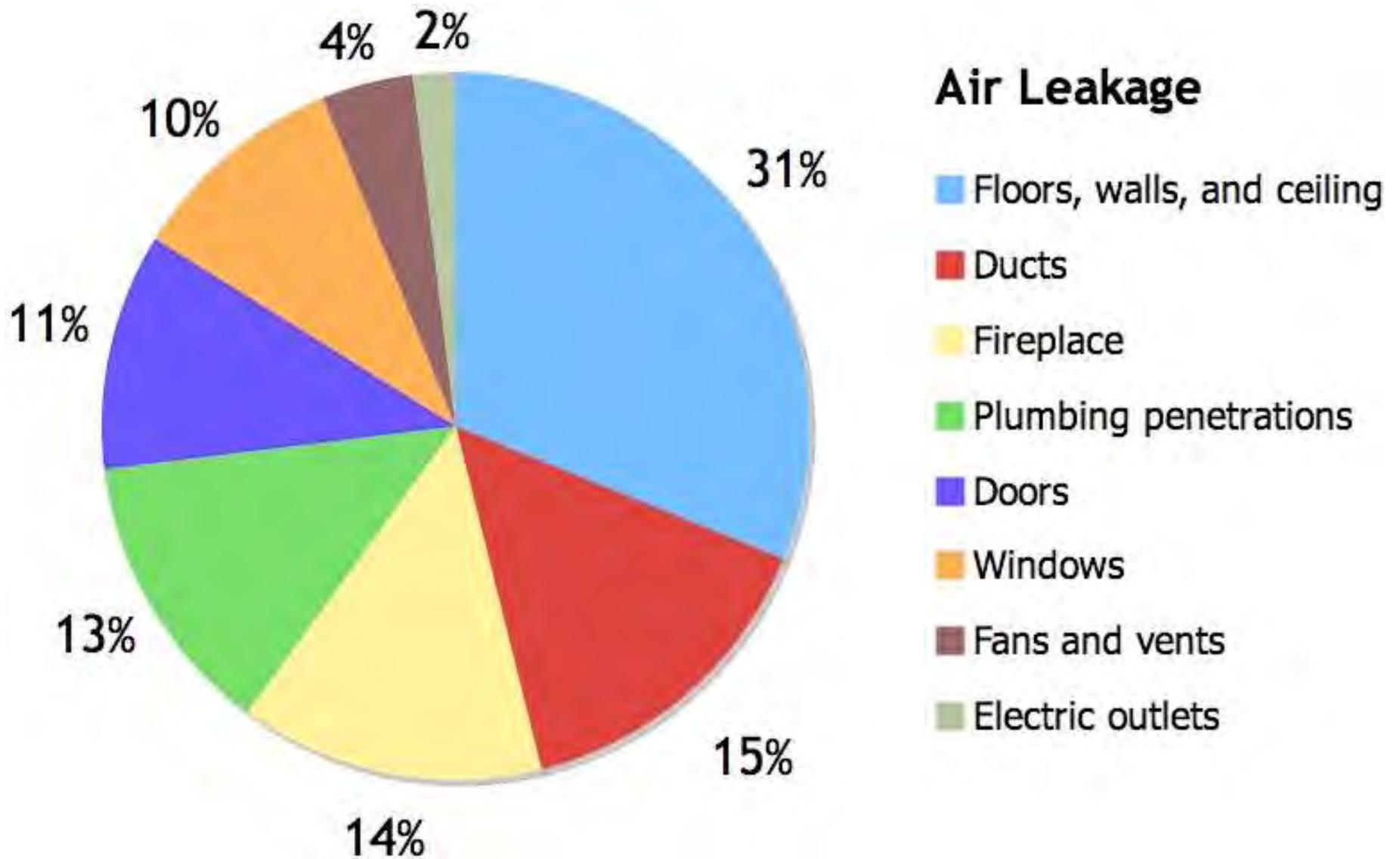
From the City of Foster City and ESTF's Creating Energy Smart Homes on 8/11/10

Every Home is a System



1. Air Flow
2. Heat Flow
3. Moisture Movement

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Source ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers)

Heat Flow: Hot \longrightarrow Cold



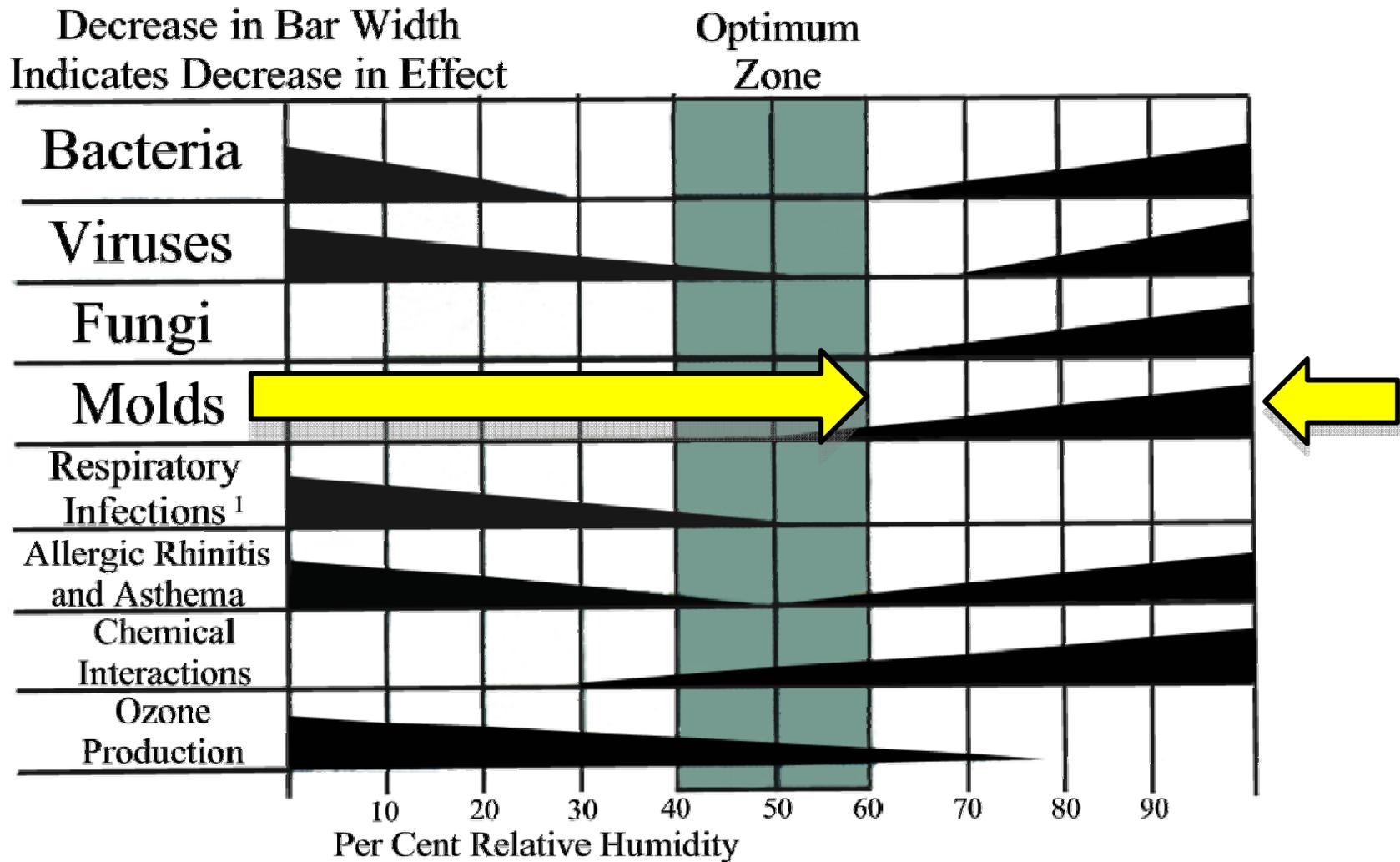
R-Value = Resistance to Heat Flow

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Moisture: Wet \longrightarrow Dry



Relative Humidity & Health



1. Insufficient data above 50% RH

Optimum Relative Humidity Ranges For Health
 From "Criteria for Human Exposure to Humidity in Occupied Buildings"
 Sterling, Arundel & Sterling ASHRAE Transactions, 1985, Vol 91, Part 1

AUDIT CASE STUDY

- Diagnose Symptoms
- Quantify Test Results
- Prioritize
- Prescribe Solution(s)

A decorative graphic at the bottom of the slide featuring a row of six stylized house silhouettes in a light green color, set against a darker green background.

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Foster City Case Study

Concerns

Root Causes

Solutions

Comfort

High Energy Bills

Health



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Diagnostic Tests: Air Leakage

- Measure Air Leakage
- Find Infiltration Points



Every year **\$13 B** worth of home heating/cooling energy is wasted due to air leaks. ~ ACEEE

Air Leakage

How drafty is your home?

Reducing air leakage is often the single most effective step you can take towards a more efficient, healthy and comfortable home. Minimizing air leakage can reduce heating and cooling bills, and improve indoor air quality and comfort. During your energy audit we used a blower door to determine the percentage of air your home exchanges with the outdoors per hour.

Air Changes Per Hour

Envelope leakage at CFM50*	3,588
Natural ACH** (Air Change Per Hour)	0.62
ASHRAE*** Recommended Level	0.35

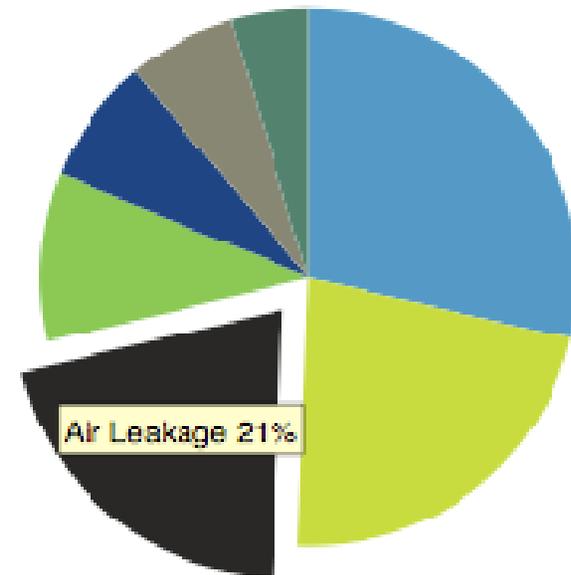
Equivalent to a 14 x 14 in² hole in your home

*Cubic Feet per Minute. Used to quantify the air flow through duct work, air infiltration, or ventilation.

**Air Changes per Hour. The number of times the home's air is replaced from outside in an hour.

***American Society of Heating, Refrigerating, and Air Conditioning Engineers.

Energy lost by air leakage, on the coldest night of the year in your area



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Attic & Crawl Space Inspection



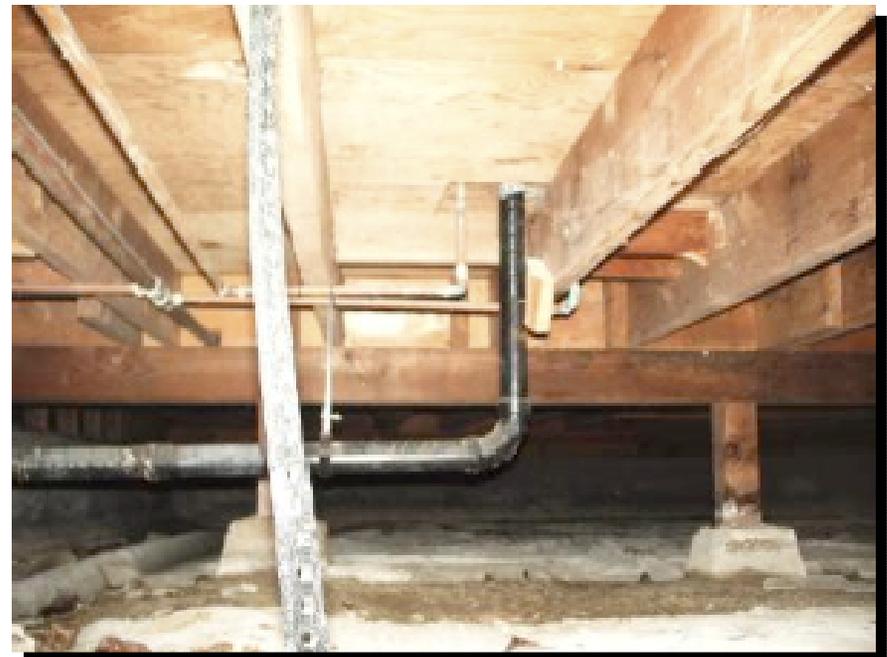
Only 20% of homes built prior to 1980 are well-insulated.

~ DoE

Up to 30% of the air in our homes originates in the crawl space.



~ ASHRAE 2007



Attic Insulation

How well is your attic insulated?

After air sealing, attic insulation is typically one of the best "bang for your buck" steps you can take towards a more efficient and comfortable home. Well installed attic insulation acts as a barrier to summer and winter heat loss to and from your attic. It's like a nice thick, winter hat for your home that saves you money all year round.

Insulation Type & R-Value

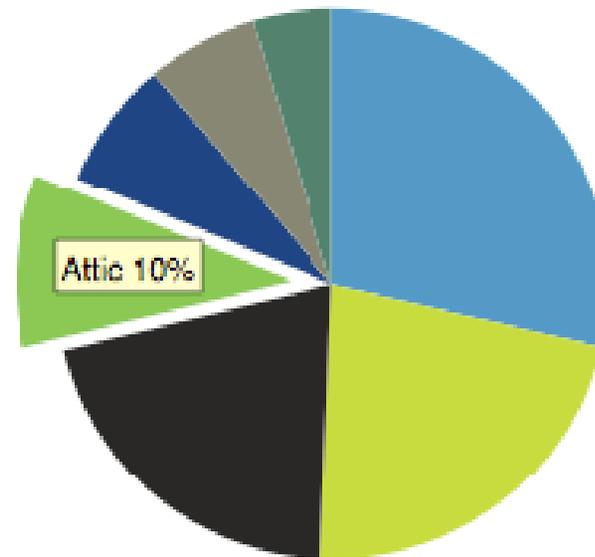
Insulation type 71% has Fiberglass, batts R-30
 Poor installation quality

Insulation type 29% has no insulation

System R-Value R-11

Recommended R-Value: R-30 or greater

Energy lost by attic, on the coldest night of the year in your area



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Duct Inspection



Indoor air contains 2 to 5 times the contaminants as outdoor air. ~ EPA

The average home duct system leaks 30% of all conditioned air.
~ CEC



Duct Leakage & Insulation

How leaky is your ductwork?

Duct leakage is a major contributor to energy waste and poor indoor air quality. A duct system should act as a closed loop in which no indoor air is lost to the outdoors and no outdoor air is introduced into your home. A well-sealed and insulated duct system is a key component to a healthy and efficient home.

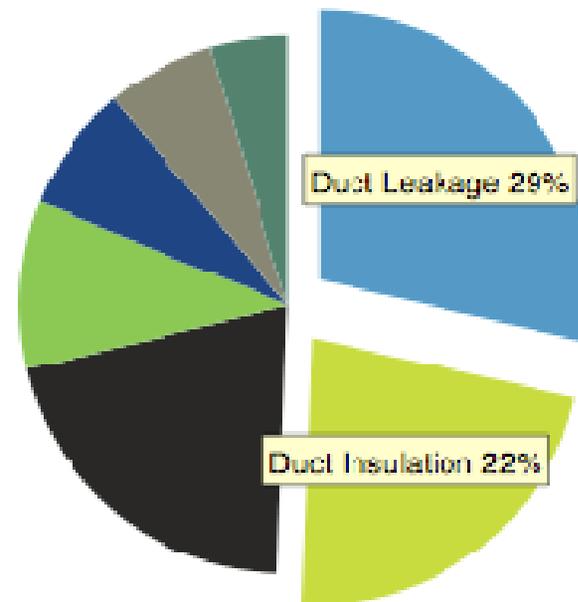
Duct Leakage & Insulation

% of Energy Lost Through Duct Leakage	28.63%
% of Energy Lost from Duct Insulation	22.01%

Insulation Level

R0 - No Insulation

Energy lost in your ducts, on the coldest night of the year in your area



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Major Systems Inspection



- Efficiency
- Flue Systems
- Carbon Monoxide
- Combustion Safety

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HVAC System Summary

How efficient are your furnace and air conditioner?

The HVAC summary compares the amount of heat your furnace can create to the amount needed by your home, and the amount of cooling your air conditioner can create to the amount needed. A properly sized furnace will reduce run-time cycling, and increase comfort and efficiency. A properly sized furnace and air conditioner combination will reduce run-time cycling, and increase comfort and efficiency.

Furnace

Brand	York
Model	ym9m100c10mp1 1a
Age	3 years
Input	100,000 BTU
Output	97,000 BTU
Draft Type	Sealed

DESIGN EFFICIENCY	97%
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CURRENT OUTPUT	97,000 BTU
ACTUAL HEATING LOAD	110,482 BTU
IMPROVED LOAD	42,224 BTU

Your system is 12% undersized for your home's requirements

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Air Balancing & Infrared Analysis



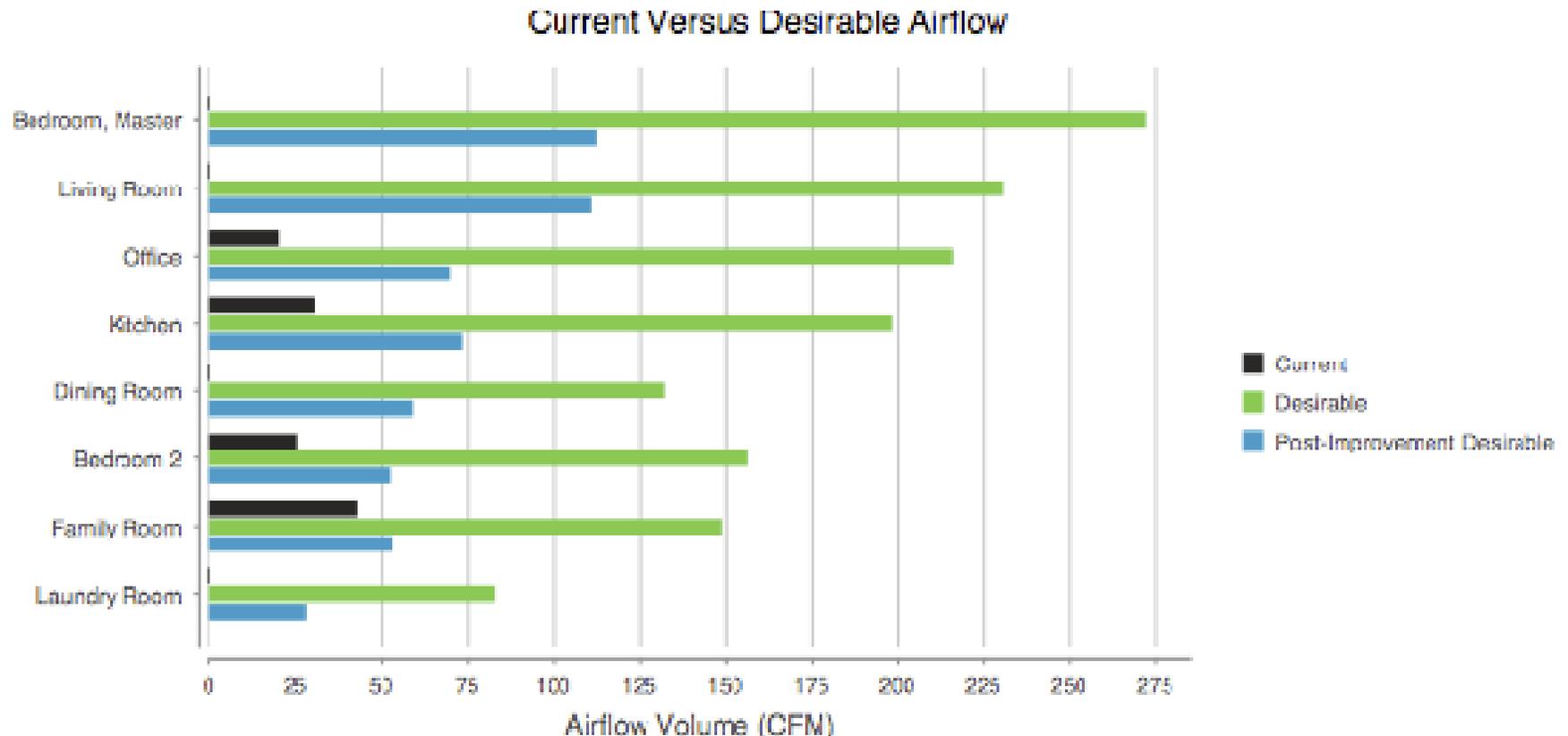
Supply Air = Return Air



Room By Room Airflow

Are your rooms getting the right amount of airflow?

By analyzing the insulation, windows, and building envelope of your home, we can determine the optimal amount of heating and cooling energy necessary for efficiency and comfort. Each room's airflow requirements are calculated using ACCA Manual J.



Energy Loss

Where is energy being lost in your home?

We have calculated your home's actual performance through a method known as Air Conditioning Contractors of America (ACCA) Manual J. This process allows us to precisely understand how each component of your building affects your heating load, and identify which areas are most appropriate to improve based on your health, comfort and efficiency goals.

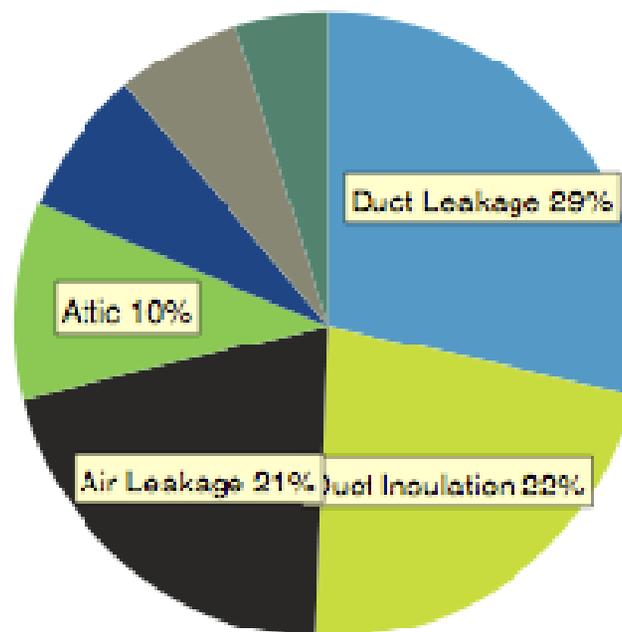
Energy Loss in Your Home

Energy loss, in BTU^h* by building component, on the coldest night of the year

Duct Leakage	31,627
Duct Insulation	24,314
Air Leakage	22,682
Attic	11,189
Floors	8,336
Walls	7,162
Windows	5,172
Total	110,482

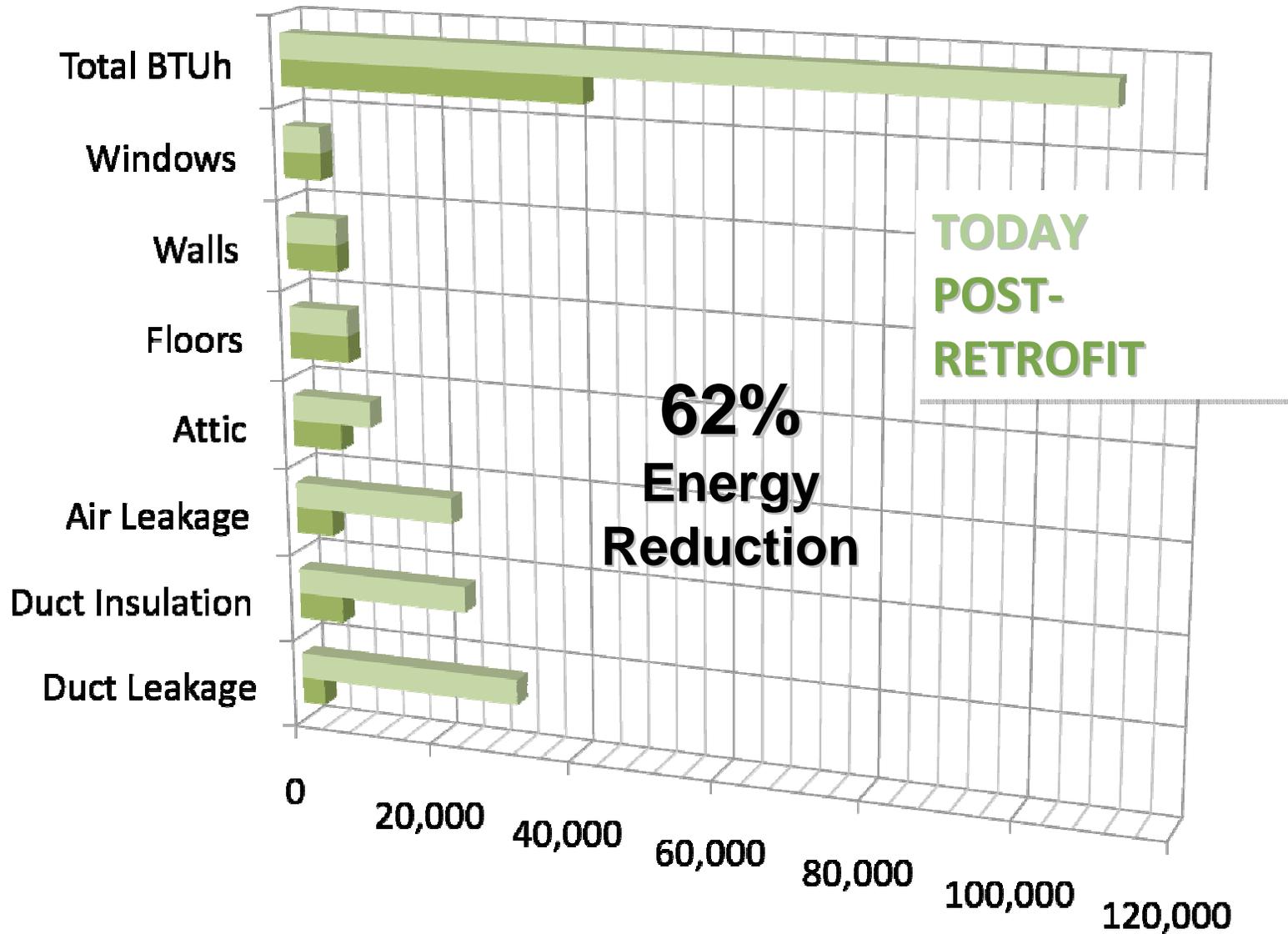
*British Thermal Unit, a unit of energy. BTU^h is used to quantify the heat loss or heat gain through the building envelope, as well as the power needed for domestic hot water

Energy loss by building component, on the coldest night of the year in your area



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Improvement Potential



Overview: Diagnosis & Prescription

Concerns

Root Causes

Solutions

Comfort

Air leakage
Broken ductwork
in attic

Air sealing

**High Energy
Bills**

Seal ducts

Health

Moisture, mold
and particulate
entry from
crawlspac

Crawlspac
moisture
barrier

RETROFIT LOADING ORDER

Fundamentals

- *Insulation*
- *Air Sealing*
- *Duct Sealing*
- *Lighting*
- *Appliances*
- *Plug Loads*
- *Behavior*

Major Systems

- *Space Heating*
- *Air Conditioning*
- *Ventilation*
- *Water Heating*

Renewables

- *Solar PV*
- *Solar Thermal*
- *Wind*
- *Water Catchment*

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“Whole-house retrofits are essential if the State is to meet existing residential energy efficiency and climate change goals.”



California Energy Commission,
State Energy Program Guidelines,
October 2009

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