Air Sealing, Insulation, HVAC, and Windows…

The Whole House Energy Upgrade Approach

Welcome

- All cell phones must be turned off or to vibrate.
- If you must take a call, please do so outside.
- Restrooms are located . . .
- Please briefly introduce yourselves. Name, company, city and what you do.

About Today's Class

We'll talk about:

- Building Science basics
- Air Sealing
- Insulation
- HVAC
- Window
- Possible Business models

Background

- The integration of Building Science efficiency measures, and energy upgrade(s) improvements can demonstrate true savings results.
- Testing protocols, software modeling, rating tools, and energy policy are moving the residential market place toward the “whole-house-as-a-system” approach.

Building Science 101

- Knowledge of building science can help remodelers improve the performance of homes
  - Cost
  - Comfort
  - Durability
  - Efficiency
  - IAQ

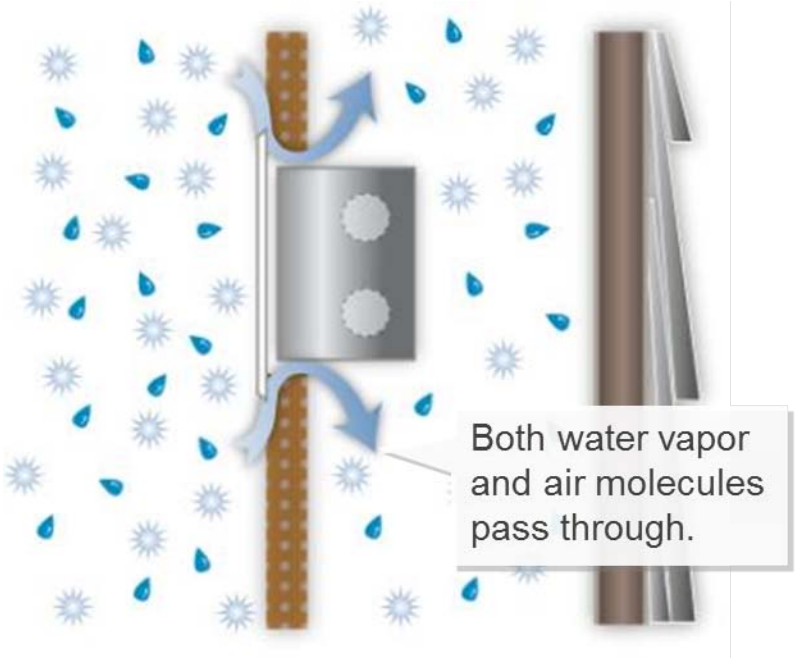
Why Building Science?

- Provides greater understanding of aspects of house and their interaction
- Enables consideration of comfort, cost, durability and efficiency
- Helps make wise trade-offs among options available

Building Science Definition

A.K.A. *building physics* or *building dynamics*

- The study of the interaction between
  - Occupants
  - Building components/systems, and
  - Environment
- Focusing on flows of
  - Heat
  - Air
  - Moisture



Occupant Focus

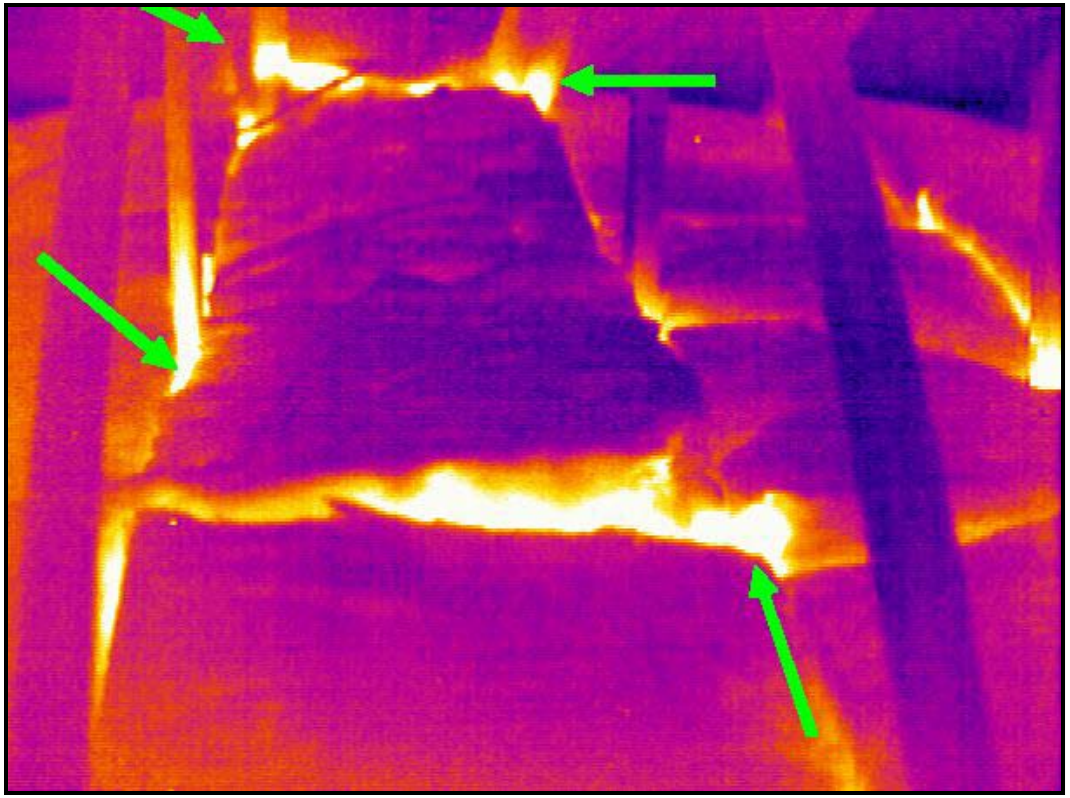
- Comfort issues
  - Even temperatures, no drafts
  - Healthy humidity levels (winter and summer)
  - Mold and other allergens
- Cost issues
  - Remodeling project
  - Energy, maintenance and repair costs

Heat, Air, and Moisture Flows in Houses

- **Heat** moves from hot → cold
- **Air** moves from higher → lower pressure
- **Moisture** moves from wetter → drier areas

Heat Flow

- Conduction
- Convection
- Radiation

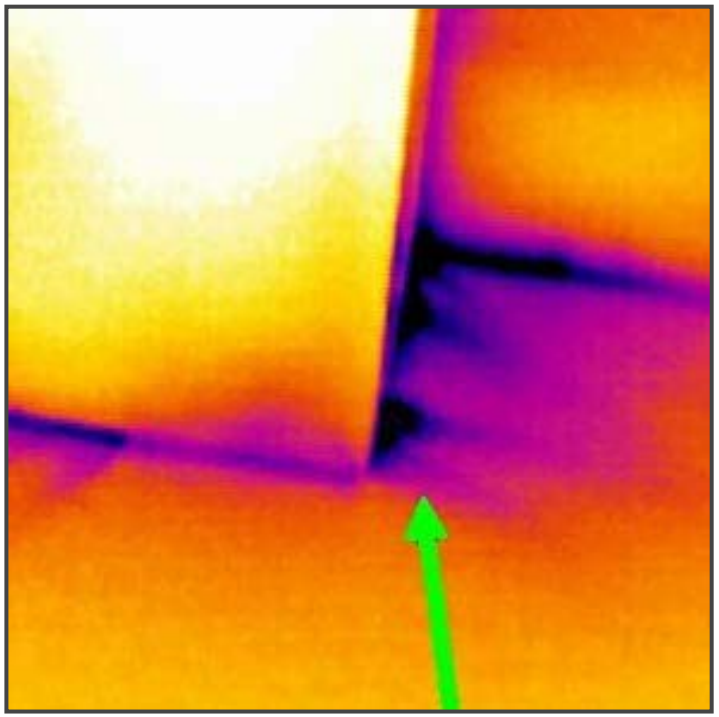


Heat Flow: Conduction

- Heat flowing through a solid material (insulation slows conduction)

Heat Flow: Convection

The transfer of heat by the movement of air
(air barriers slow convection)

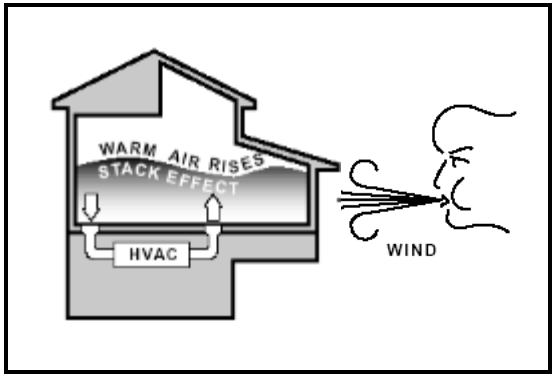


Heat Flow: Radiation

The movement of heat from a hot to a cold surface with nothing in between

Air Movement and Infiltration

- Conditions for air infiltration
  - Pressure difference (high to low)
  - Penetrations in building envelope (holes and cracks)
- Driving forces
  - Temperature difference (stack effect)
  - Wind
  - Mechanical systems

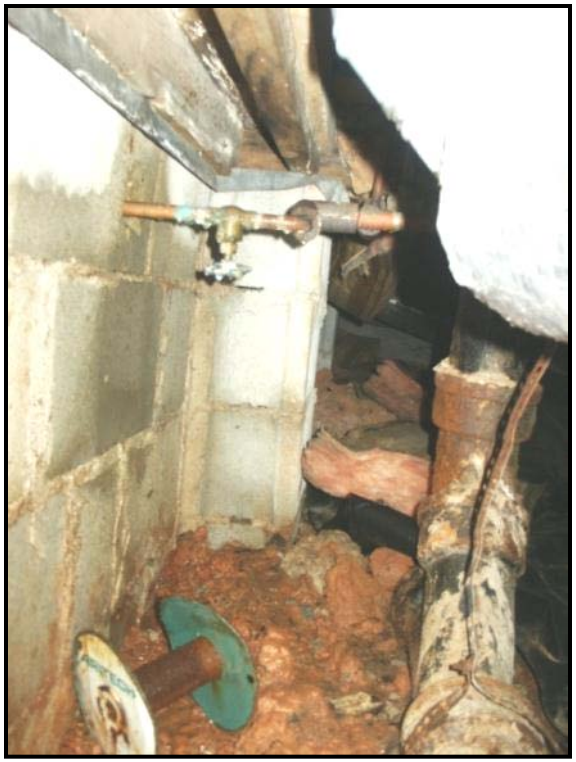


Moisture Flow in Buildings

Moisture flows in two forms:

LIQUID	VAPOR
Bulk	Diffusion
Capillary	Infiltration

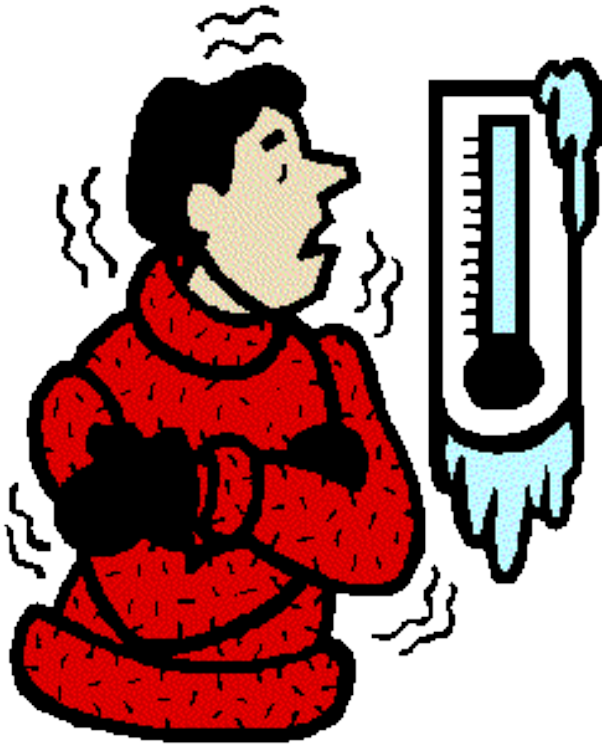
Encountering Bulk Moisture



Encountering Water Vapor

Impact of Environment on Home and Occupants

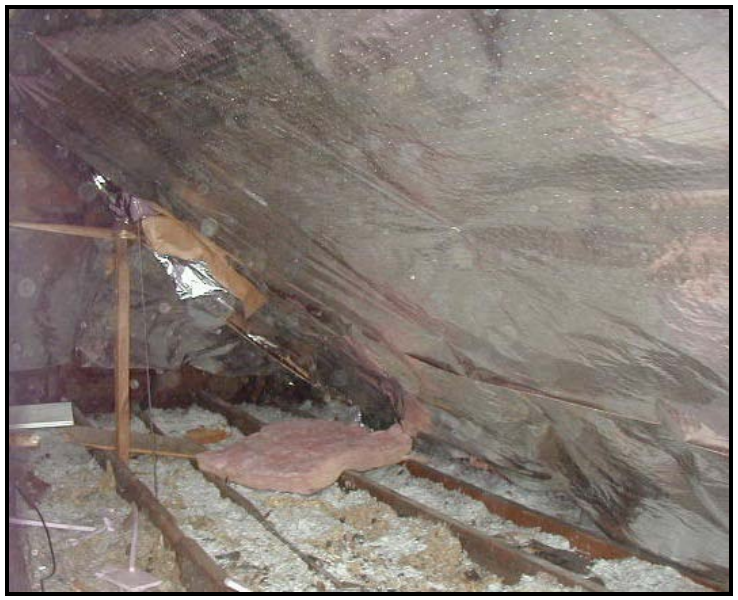
- Factors affecting human comfort
  - Temperature
  - Relative humidity
  - Precipitation
  - Wind
  - Solar radiation

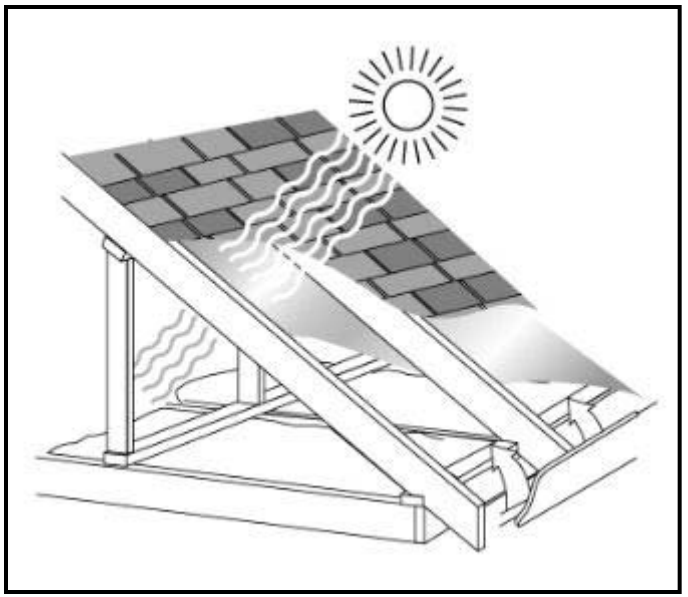


Strategies to Control Radiation (heat) Gain

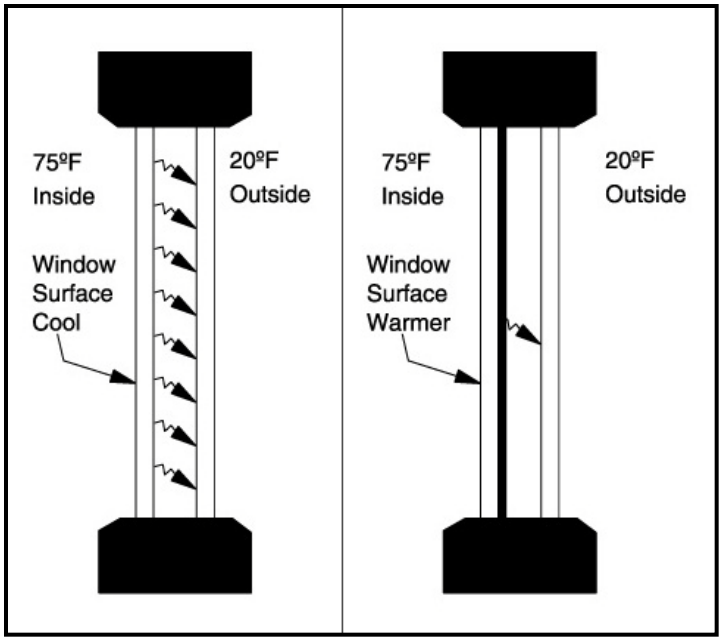
- Radiant barrier in attic
- Low-E windows
- Infrared-reflective roofing
- Shading devices
- Roof overhangs

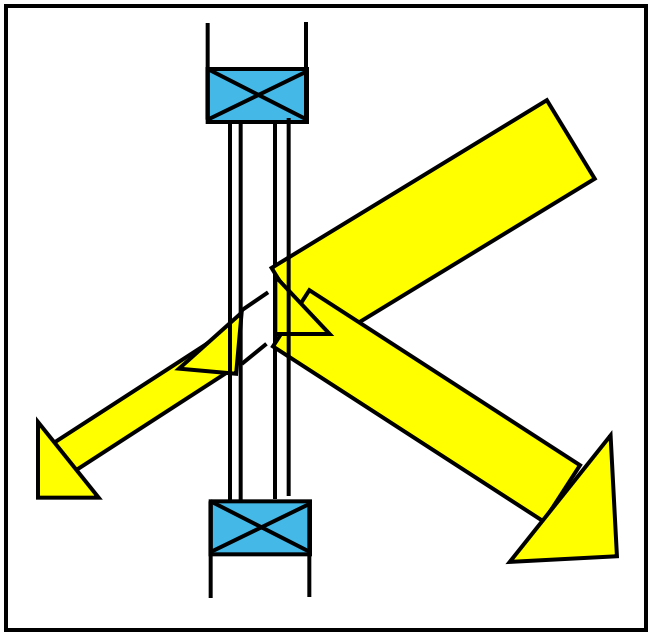
Controlling Radiation
Radiant Barriers





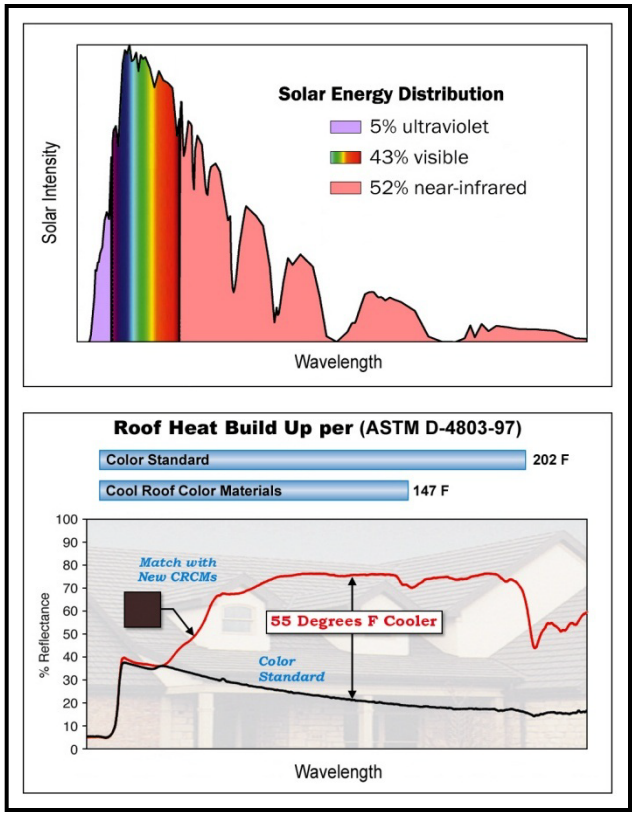
Controlling Radiation Low-E Windows





A low-E window optimized for summer would likely have the coating on the outer pane's inside surface

Controlling Radiation
IR Reflective Roofing

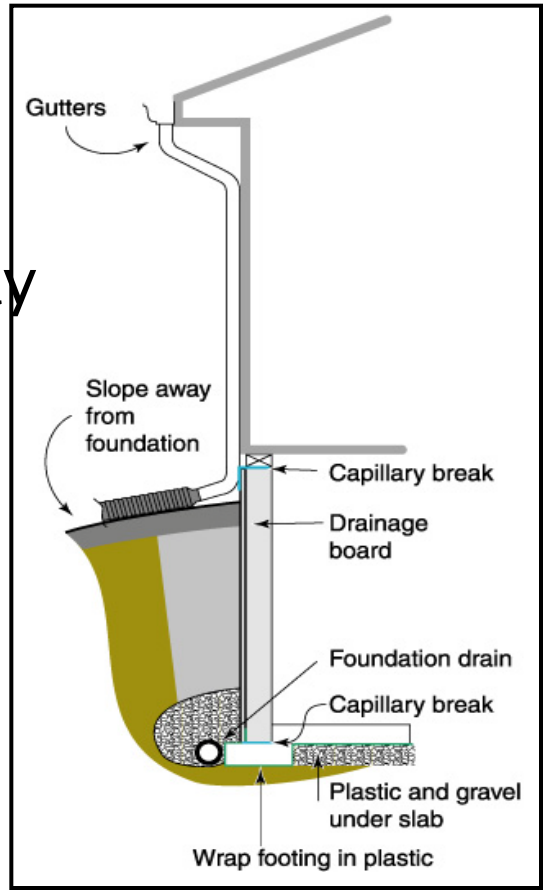


Strategies to Control Moisture Flow

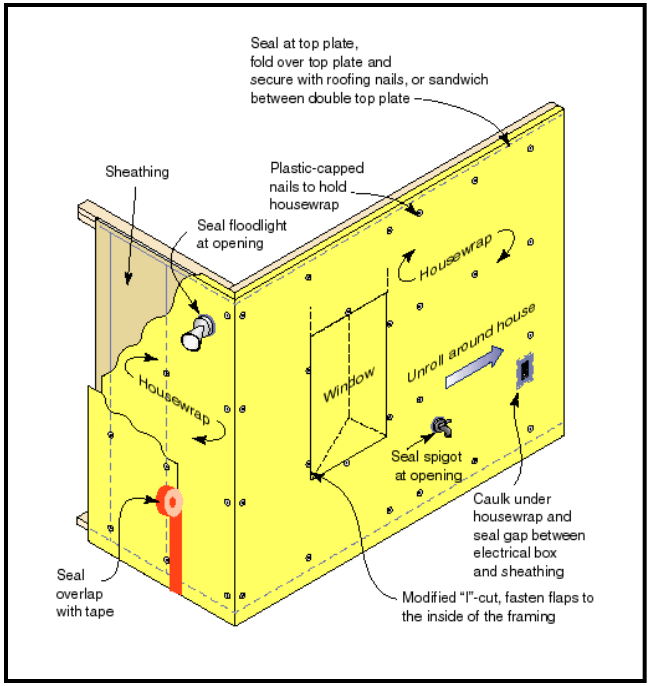
- Bulk moisture at foundations
- Bulk and vapor moisture at walls
- Bulk moisture at window flashing
- Bulk moisture through design
- Vapor moisture with material's permeability

Bulk Moisture Control Foundations

- Proper site drainage
- Foundation waterproofing
- Plastic ground cover
- Gutters channel water away from foundation



Bulk and Vapor Moisture Walls (House wrap Weather Barrier)



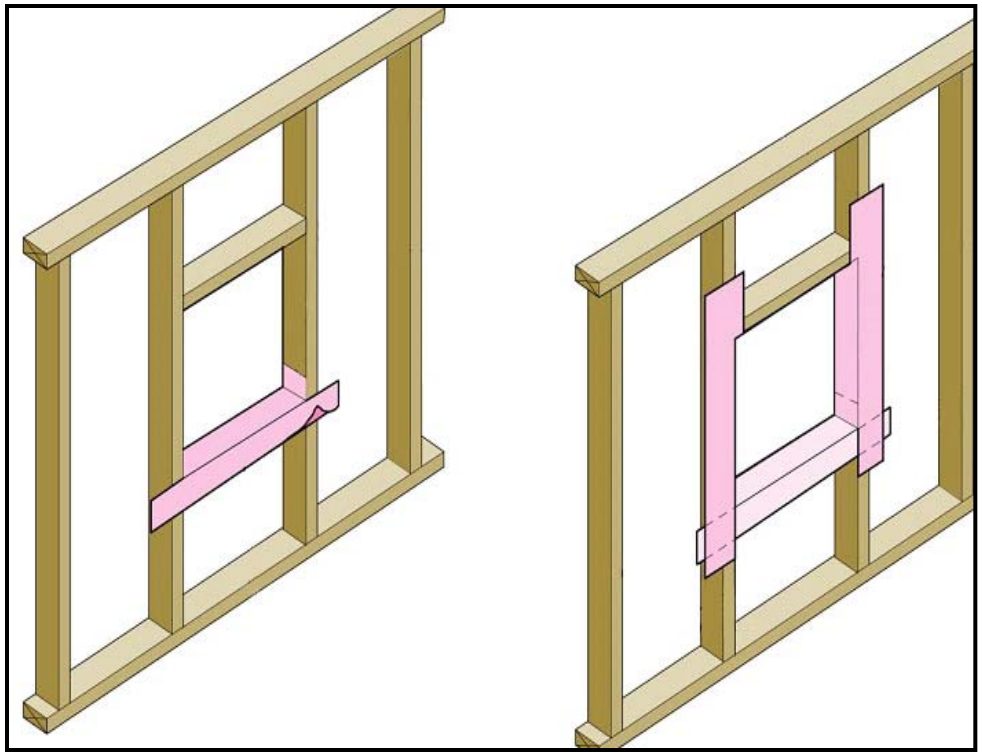
Bulk Moisture Control
Walls – House wrap Details

Top Sash after trim removed

Rotten Header

Windows (incorrectly) have flange over house wrap

Bulk Moisture Control Walls – Window Flashing



Bulk Moisture Control By House Design

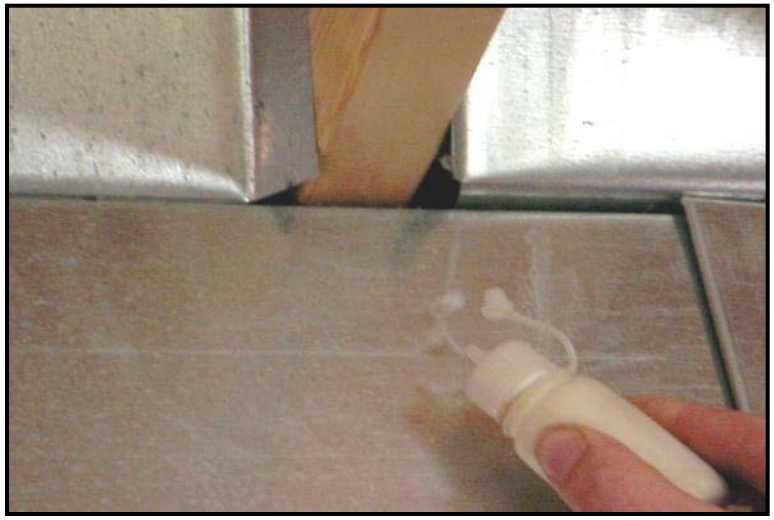
Building Science Diagnostic Tools

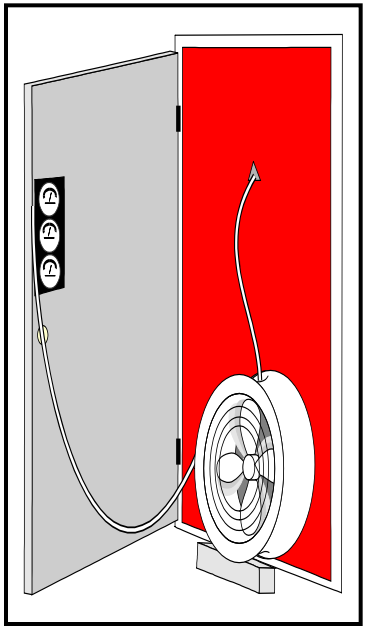
- Blower door testing
- Duct pressure testing
- Duct flow testing
- Infrared imaging
- Pressure differential testing

Diagnostic Tool: Blower Door Testing

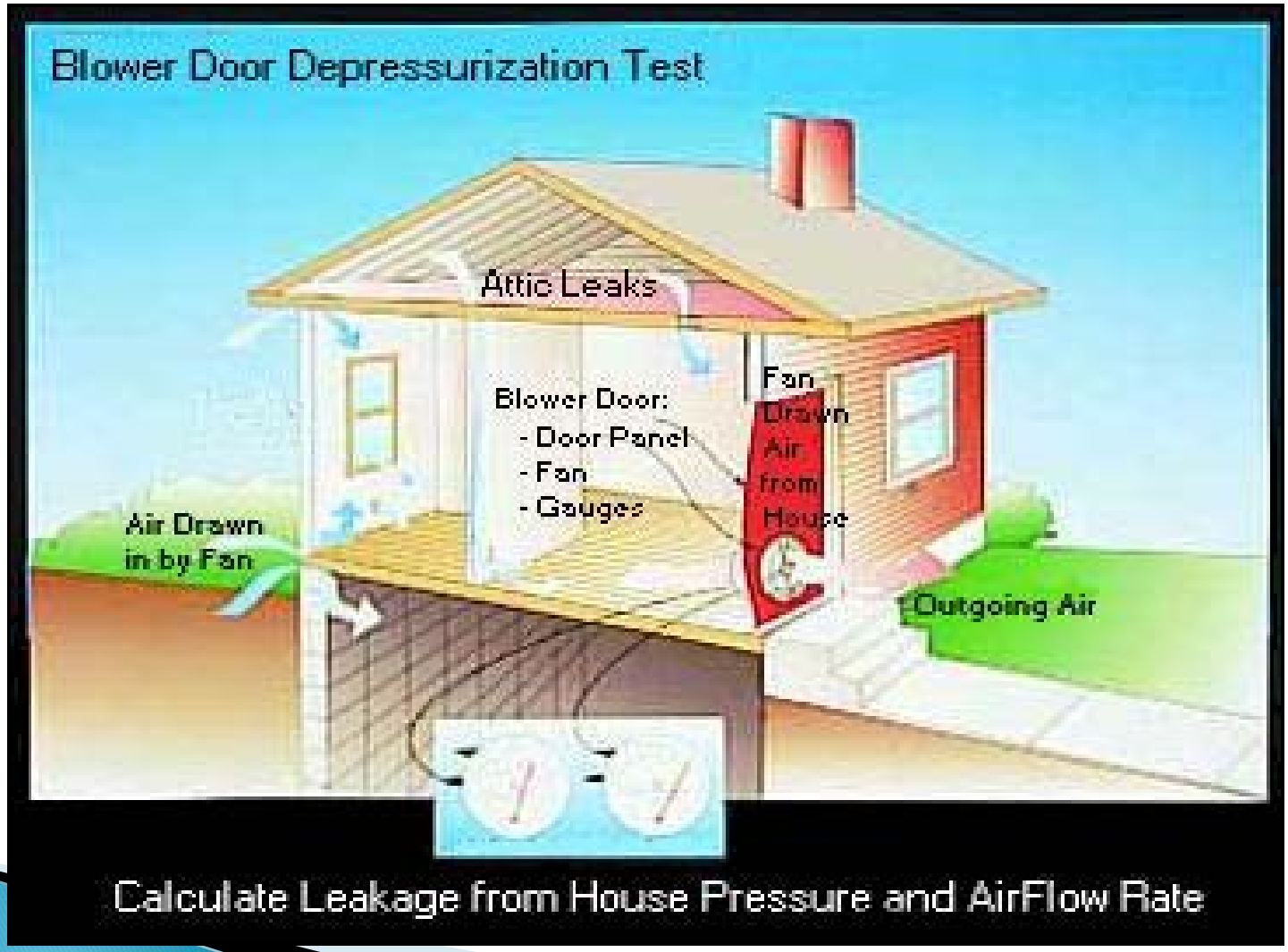
Blower Door Testing

- Provides a measurement of the actual infiltration rate
- One tested home can be compared to another
- Helps identify leak paths



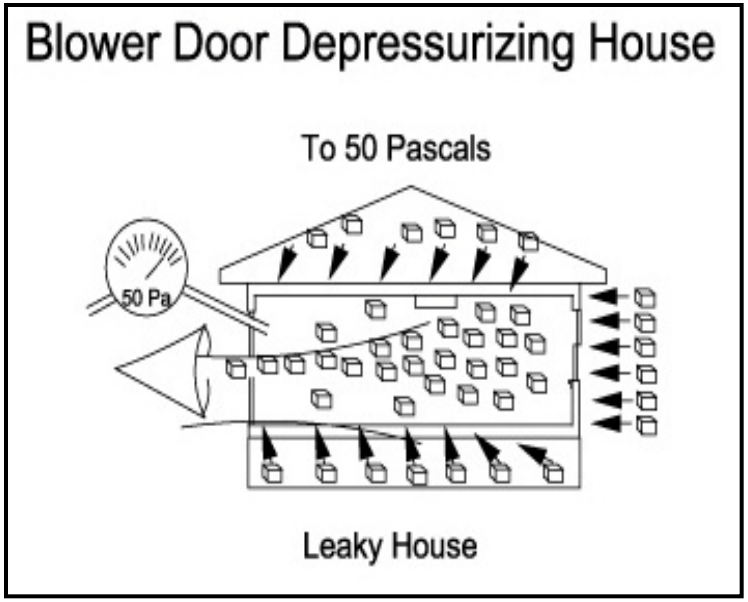


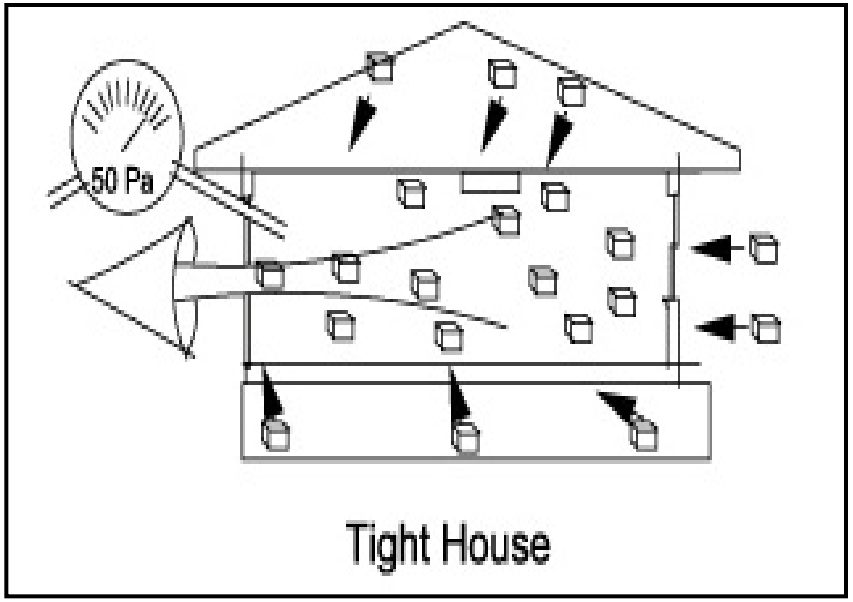
Blower Door Testing



Blower Door Testing

Tight vs. Leaky House

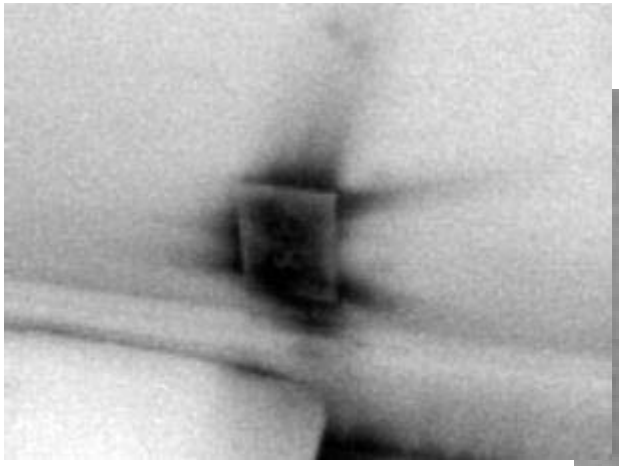


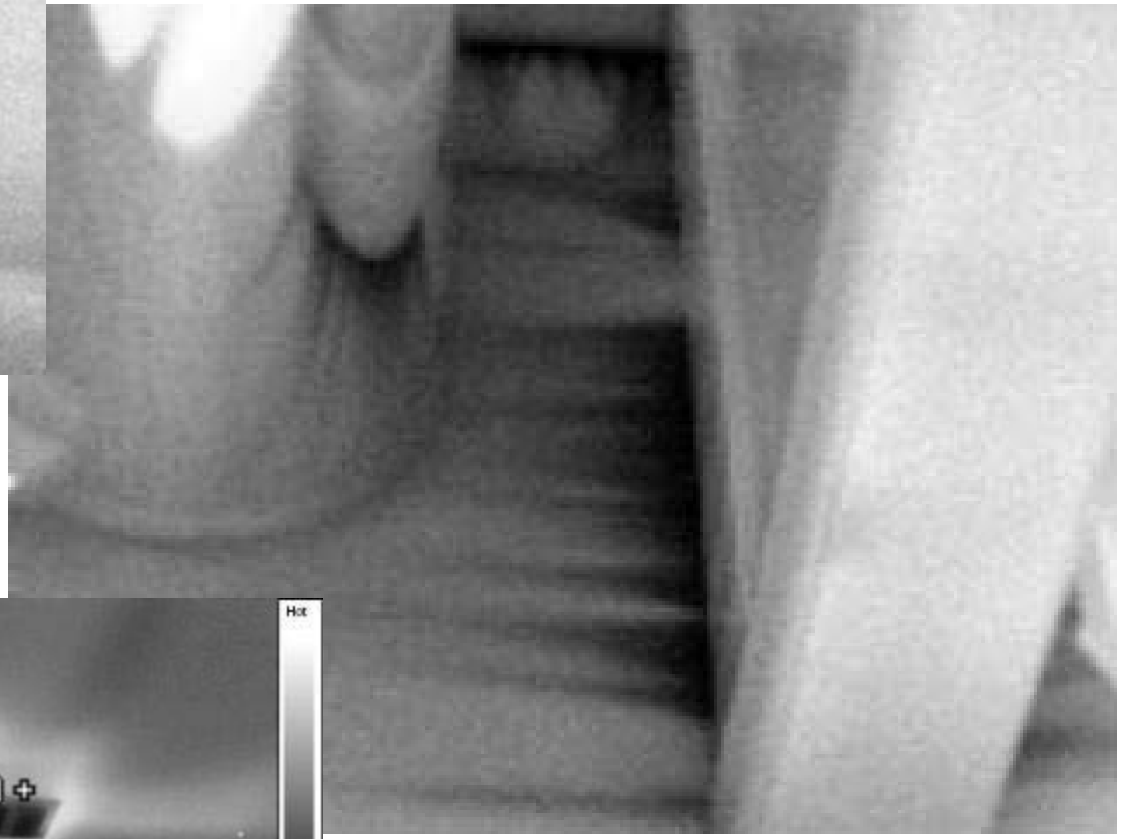


Duct Pressure Testing

Pressure test finds leaks and estimates air flow

Infrared Imaging



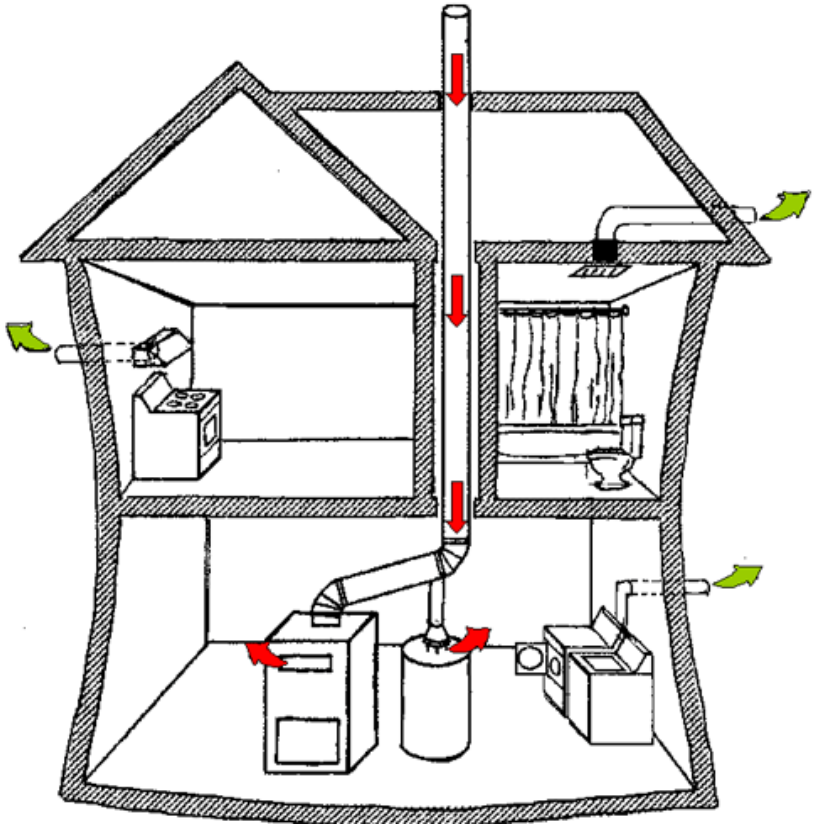


CO testing

Dangers of Carbon Monoxide (CO)

PPM CO	Time	Symptoms
35	8 hours	Maximum exposure allowed by OSHA in the workplace over an eight hour period.
200	2-3 hours	Mild headache, fatigue, nausea and dizziness.
400	1-2 hours	Serious headache-other symptoms intensify. Life threatening after 3 hours.
800	45 minutes	Dizziness, nausea and convulsions. Unconscious within 2 hours. Death within 2-3 hours.
1600	20 minutes	Headache, dizziness and nausea. Death within 1 hour.
3200	5-10 minutes	Headache, dizziness and nausea. Death within 1 hour.
6400	1-2 minutes	Headache, dizziness and nausea. Death within 25-30 minutes.
12,800	1-3 minutes	Death

“Worst-Case-Scenario” CO testing



Did you know that…

Installing this…

…could lead to this?

Summary

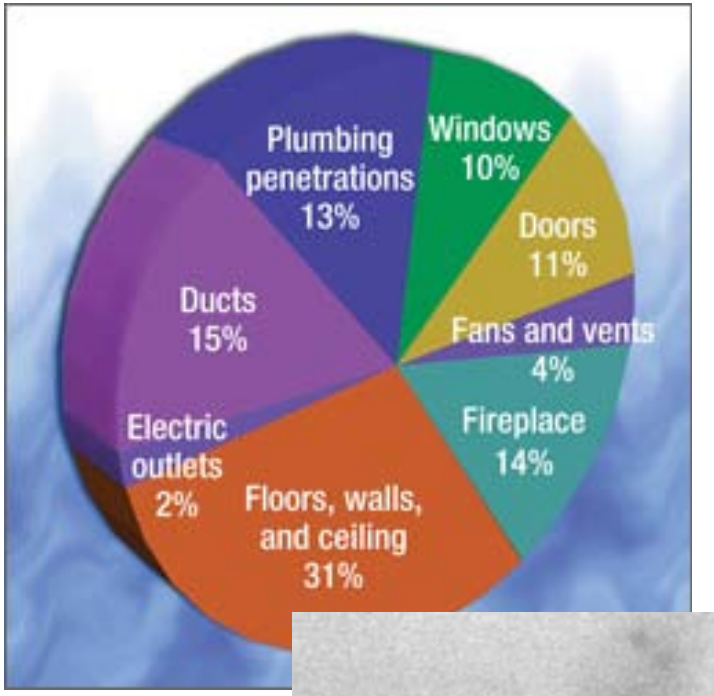
- Building science studies the interaction between occupants, building components and systems, and the environment by focusing on flows of heat and air
- Use building science to help you improve the performance (cost, comfort, durability, and efficiency) of homes
- Diagnostic tools will help you understand how and why your project is performing as it is

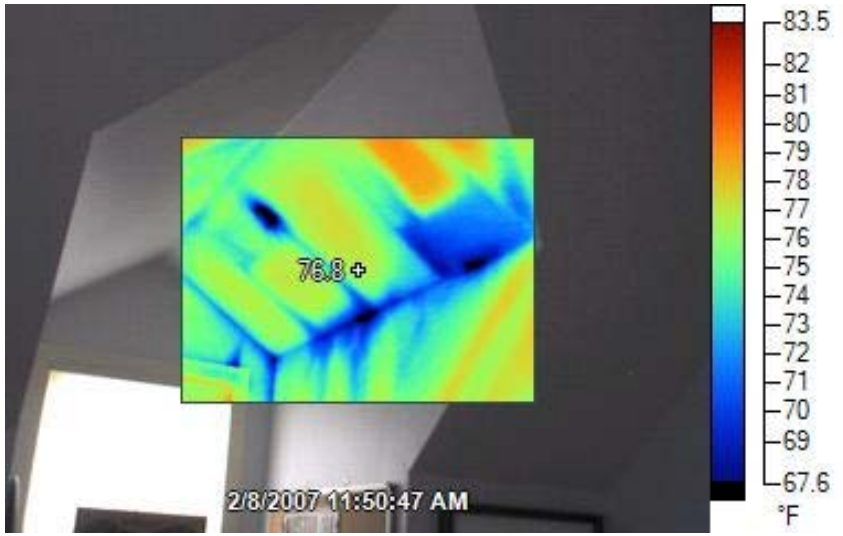
Air Sealing

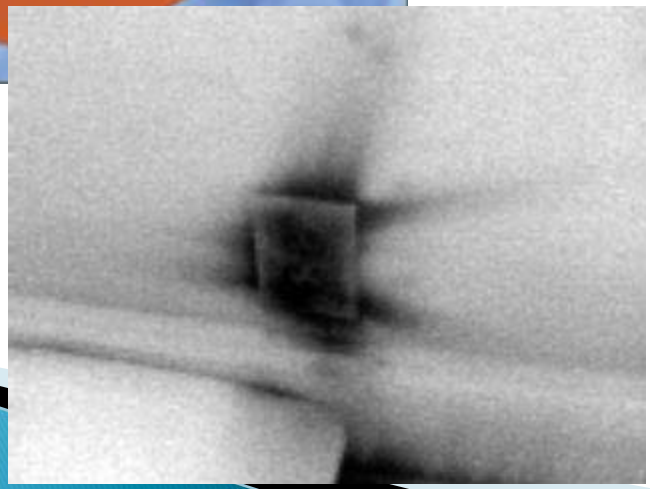
Strategies to Control Air Flow:

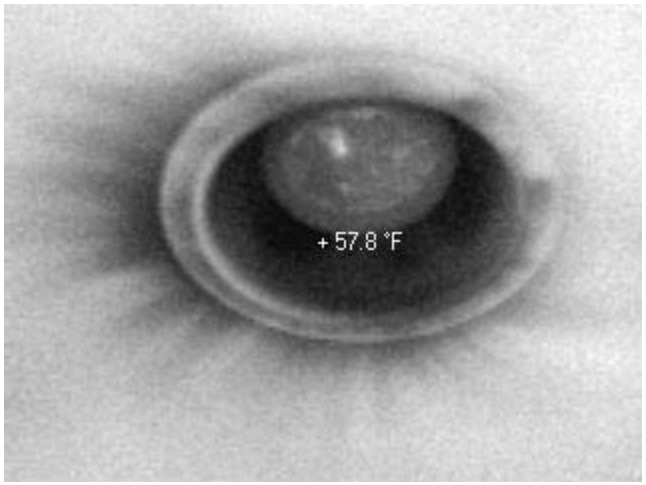
- Block infiltration and convection pathways to attics and crawlspaces
- Seal leaky joints in walls, floors and ceilings
- Seal attic scuttles
- Seal ductwork in unconditioned space
- Repair/Replace leaky doors and windows
- Balance pressures within house

Areas of air infiltration







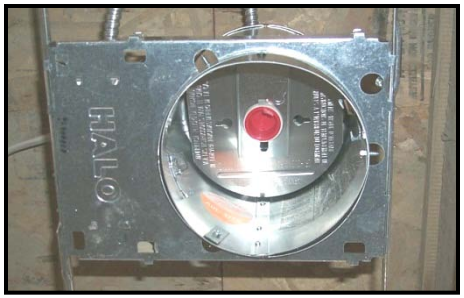


Air Flow Examples
Pathways in Attics

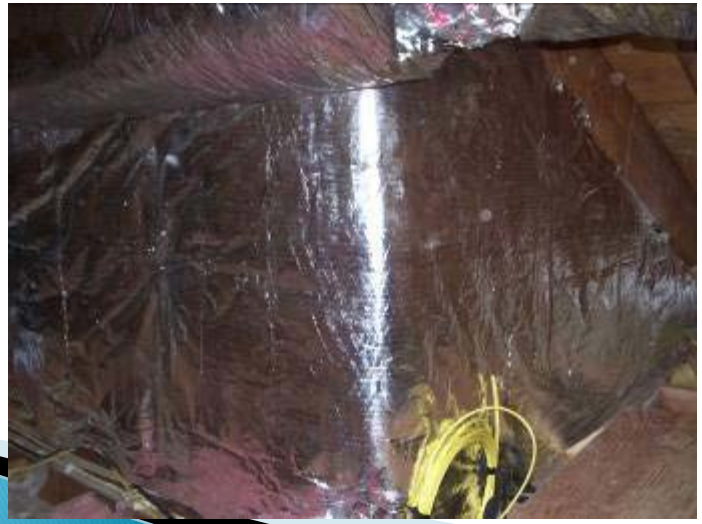
Air Flow Examples
Pathways in Knee walls

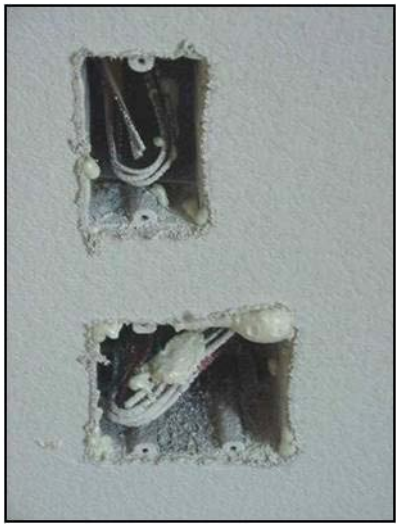
Air Sealing after Drywall

- Outlets to drywall
- Fixtures to drywall
  (recessed lights airtight + IC-rated)
- Boots to drywall
- Attic stairs to drywall



Attic Air Sealing after Drywall





Air Sealing after Drywall

- Attic scuttle holes must seal tight – requires weather-stripping

Controlling Air Flow Windows and Doors

Seal rough openings with caulk, backer rod or expanding foam

Can A Home Be Too Tight?

MYTH - "Sealing air leaks is a cause of indoor air quality problems"

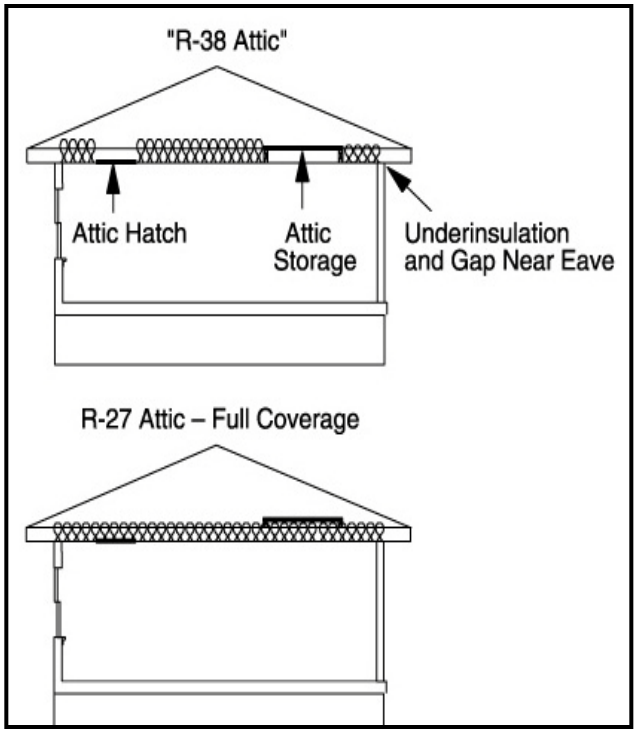
FACT - Any home can have air quality problems

Sealing air leaks can help keep pollutants out

The best strategy is to use non-polluting building materials and household products, and provide CONTROLLED mechanical Ventilation

Insulate to Reduce Conduction

Installing Insulation Correctly is the key!



R-38 installed with 5% gaps or uninsulated areas yields the same heat loss as R-27 with full coverage - a 30% reduction!

1000 s.f of Attic

950 s.f. is R-38

50 s.f. is R-4

$$R_{avg} = \frac{R_1 x A_1 + R_2 x A_2}{A_{Total}}$$


A+

Alternate Insulation
Blown Cellulose

Insulation Remediation

Insulation Remediation

Insulation Remediation

Alternate Insulation
Spray-applied Foam

The Myth of Focusing on Insulation

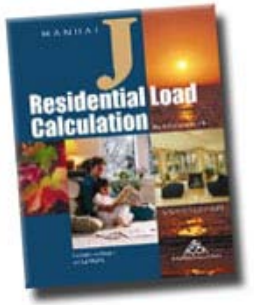
- **Myth:** To improve the energy efficiency of a home, just add more insulation!

- **Energy Fact:** Reducing air infiltration can improve energy efficiency more than insulation.

Tradeoffs: Increased Insulation vs. Reduced Air Leakage

	Annual Utility Bill Savings	
	ACH .80→.40	Attic Insul. R-11→R-38
Ft. Worth, TX	$162	$73
Raleigh, NC	$177	$83
Syracuse, NY	$394	$248

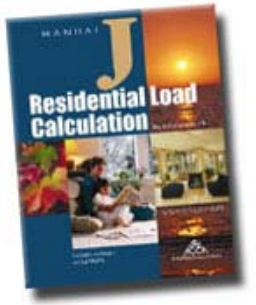
HVAC Systems
1st step: Design Conditions



I must know what I am dealing with so, I calculate the Heat Load (using Manual J) on my home by analyzing:

- my **climate** specifics
- my home's design and **construction** (sf, volume, walls, roof, floor, insulation level, leakage rate, # of occupants, etc.)
- my comfort "**design temperature**"
- I use ACCA **Manual J** methodology for this

HVAC Systems
1st step: Determining Loads



I Calculate the home's Heating & Cooling **Load** to see how many Btu's of heating & cooling I'll need to hold my home at the summer and winter design temperatures

In all codes since 1983, yet done very little.

Building HVAC Requirements – Heating Equipment Page 4-7

Equipment Sizing

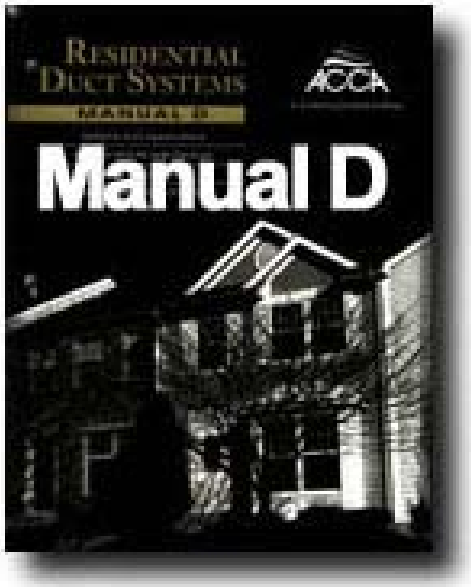
§150(h)

The Standards do not set limits on the sizing of heating equipment, but they do require that heating loads be calculated for new heating systems. Oversized equipment typically operates less efficiently and can create comfort problems due to excessive cycling and high airflow.

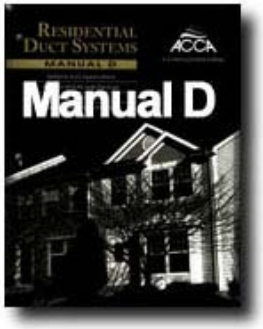
Acceptable load calculation procedures include methods described in the ASHRAE Handbook – Equipment, ASHRAE Handbook – Applications, ASHRAE Handbook – Fundamentals, SMACNA Residential Comfort System Installation Manual, or ACCA Manual J.

HVAC Systems
2nd step: Duct Design

- Now, I know my home's heat load
- Next, I design my **duct system**
- For this, I use ACCA **Manual D** (distribution/duct)

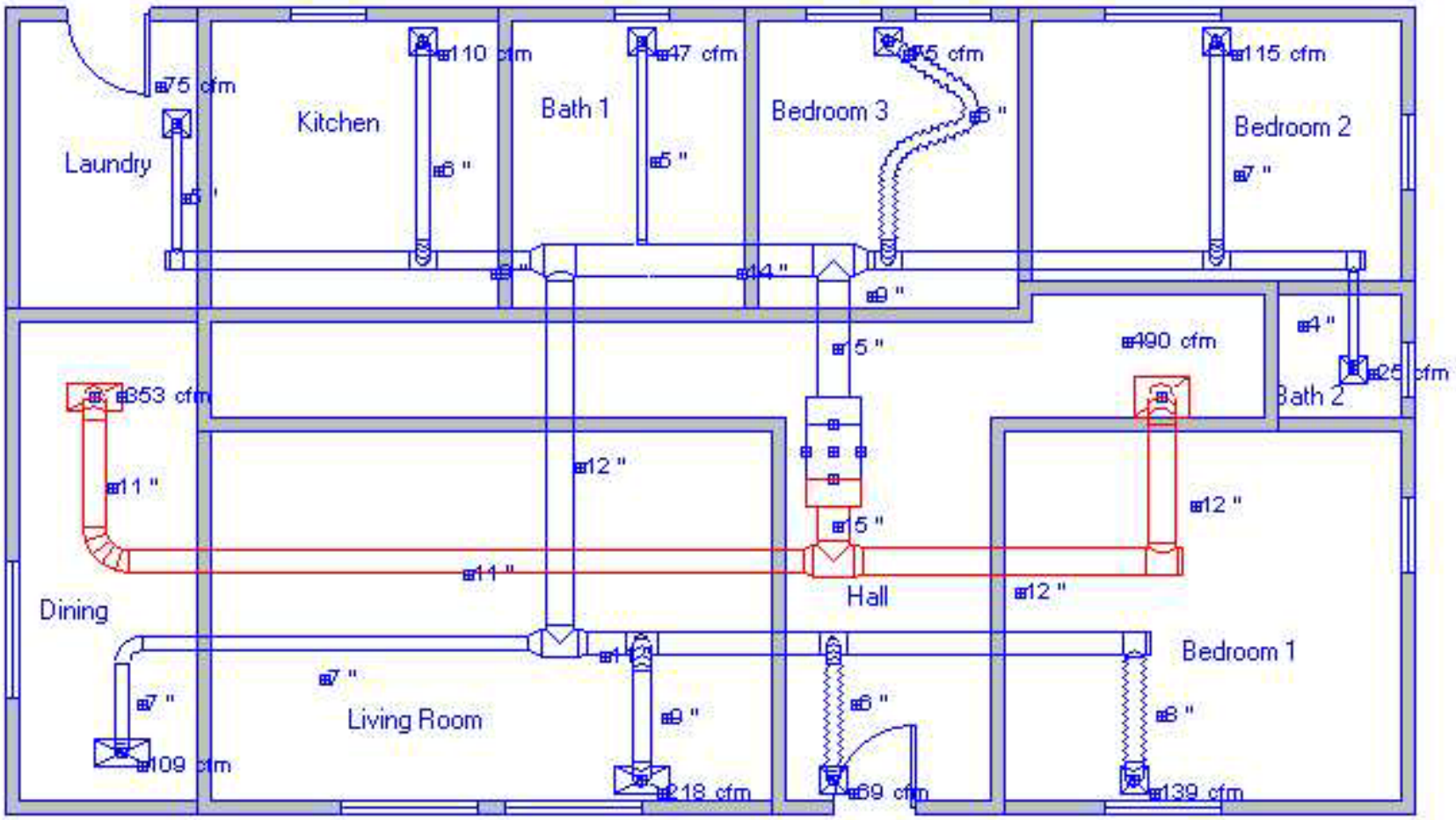


HVAC Systems
2nd step: Duct Design



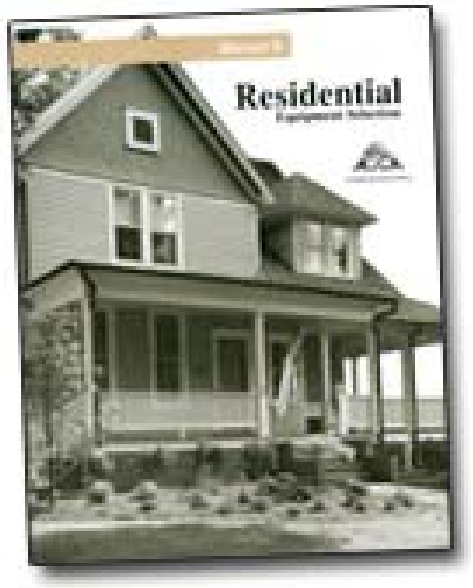
- I plan on how much air I need in the home and individual rooms to maintain my desired design temperature
- I look at my **duct layout**, size of ducts, duct insulation, types and placement of registers, and air flow and pressures
- I make adjustments and end up with a designed system that will **effectively distribute** air in my home

HVAC Systems
2nd step: Duct Design



HVAC Systems
3rd step: Equipment Selection

- Now, I know my home's heat load and the design of my duct system
- Next, I find heating and cooling **equipment** that fits my home's load and distribution system
- For this, I use ACCA **Manual S**



HVAC Equipment Location

Ideally equipment is installed–

- **close to the delivery** location
- **not in a Cold/Hot attic** or on roof
- In “conditioned” space if possible

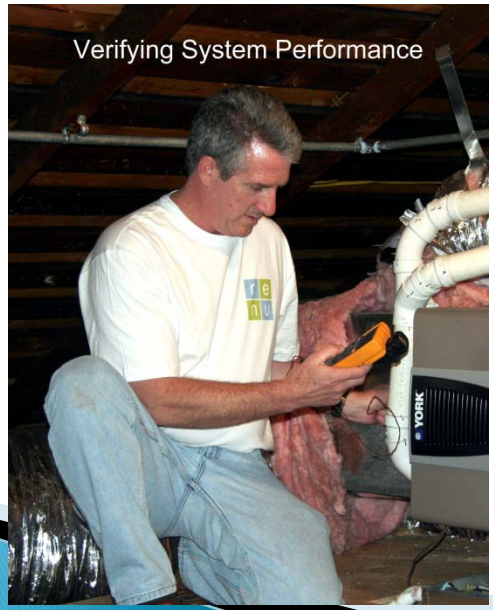
Furnace – Installation

Confirm the Following:

- **Efficient Combustion**; adjusting gas valve gas pressures for the most efficient burn and proper BTU content
- Adjust fan speed to **match the Manual J/D** duct design total CFM
- Measure **Temperature Rise** and **Static Pressure** and compare to manufacture specifications

HVAC Testing

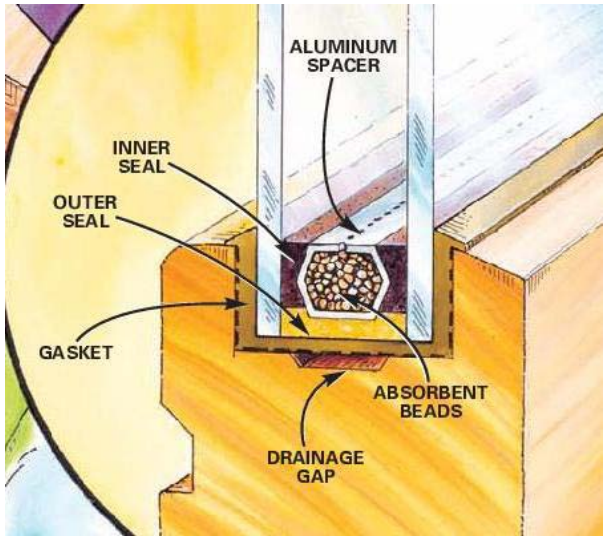
- Assessing HVAC systems for performance is essential in any energy upgrade
  - Age of system
  - Equipment Efficiency
  - Duct Tightness/Effectiveness

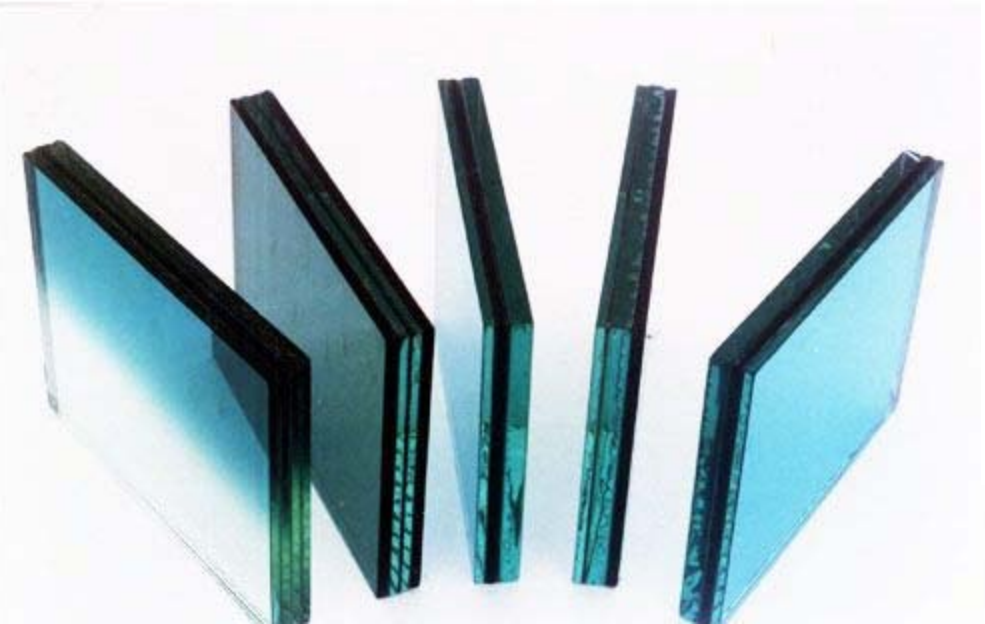


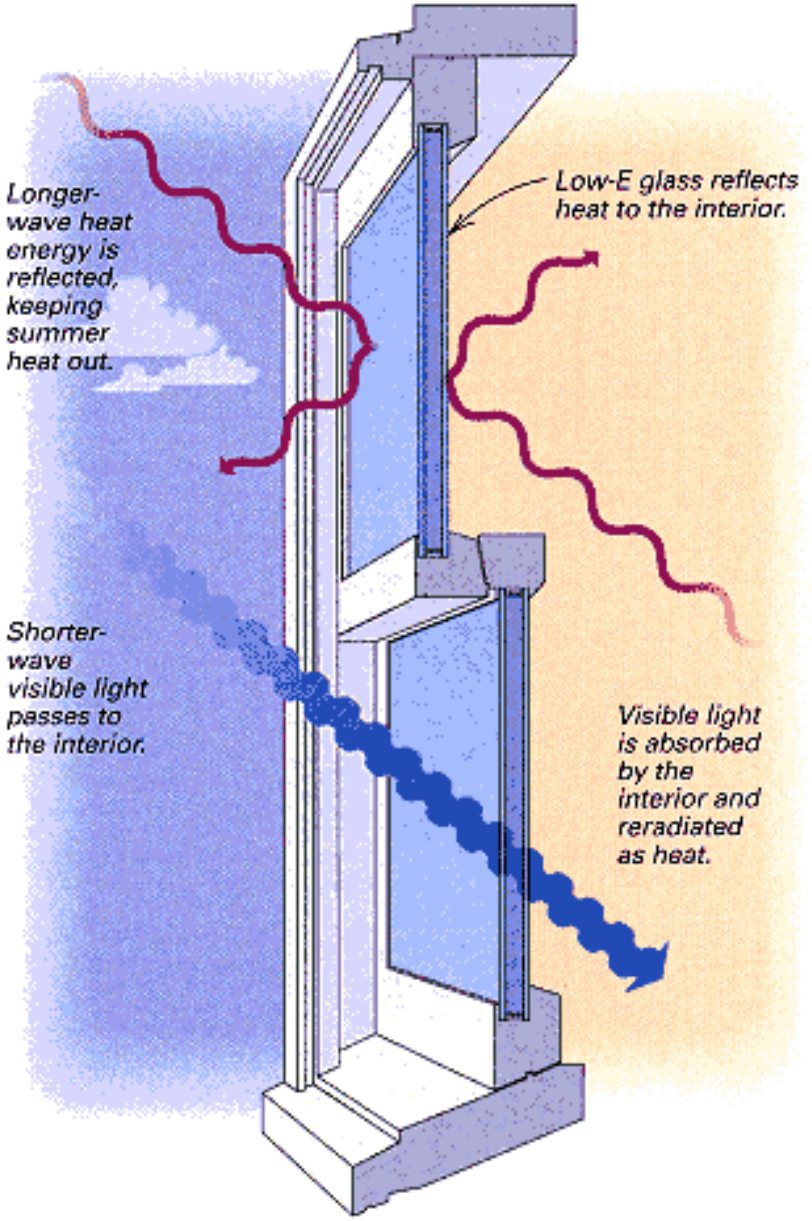
Attaching to a ceiling return.

Attached to a wall return.

Windows


ALUMINUM SPACER
INNER SEAL
OUTER SEAL
GASKET
ABSORBENT BEADS
DRAINAGE GAP



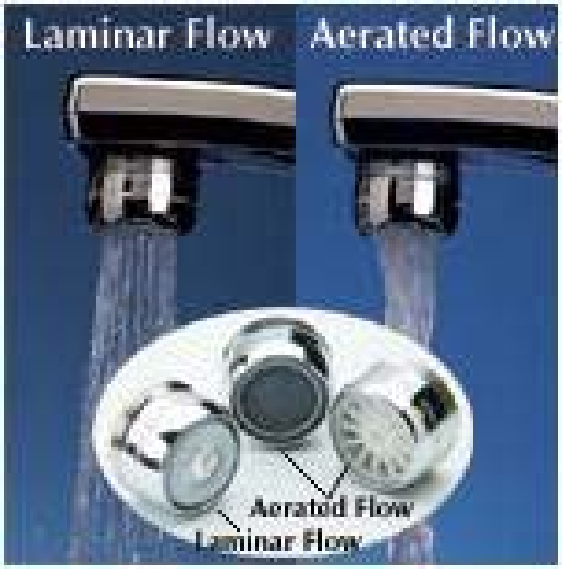

Longer-wave heat energy is reflected, keeping summer heat out.
Low-E glass reflects heat to the interior.
Shorter-wave visible light passes to the interior.
Visible light is absorbed by the interior and reradiated as heat.

Reducing Loads (Energy Use)

- Tightening the air barrier is the most cost-effective in most climates
  - Air Sealing
  - Repair/Replace poor performing windows/doors
- Improve Thermal Boundary (insulation layer)
  - Air seal first, then increase R-Value
  - Make sure thermal layer is in contact with air barrier
- Size HVAC AFTER improvements/measurements have been made
  - Smaller equip? Consider combined-hydronics
  - Ensure occupant comfort/IAQ
- Assess all energy consuming systems
  - Lighting/Appliances
  - Landscape/Pools/Pumps
  - Phantom Loads

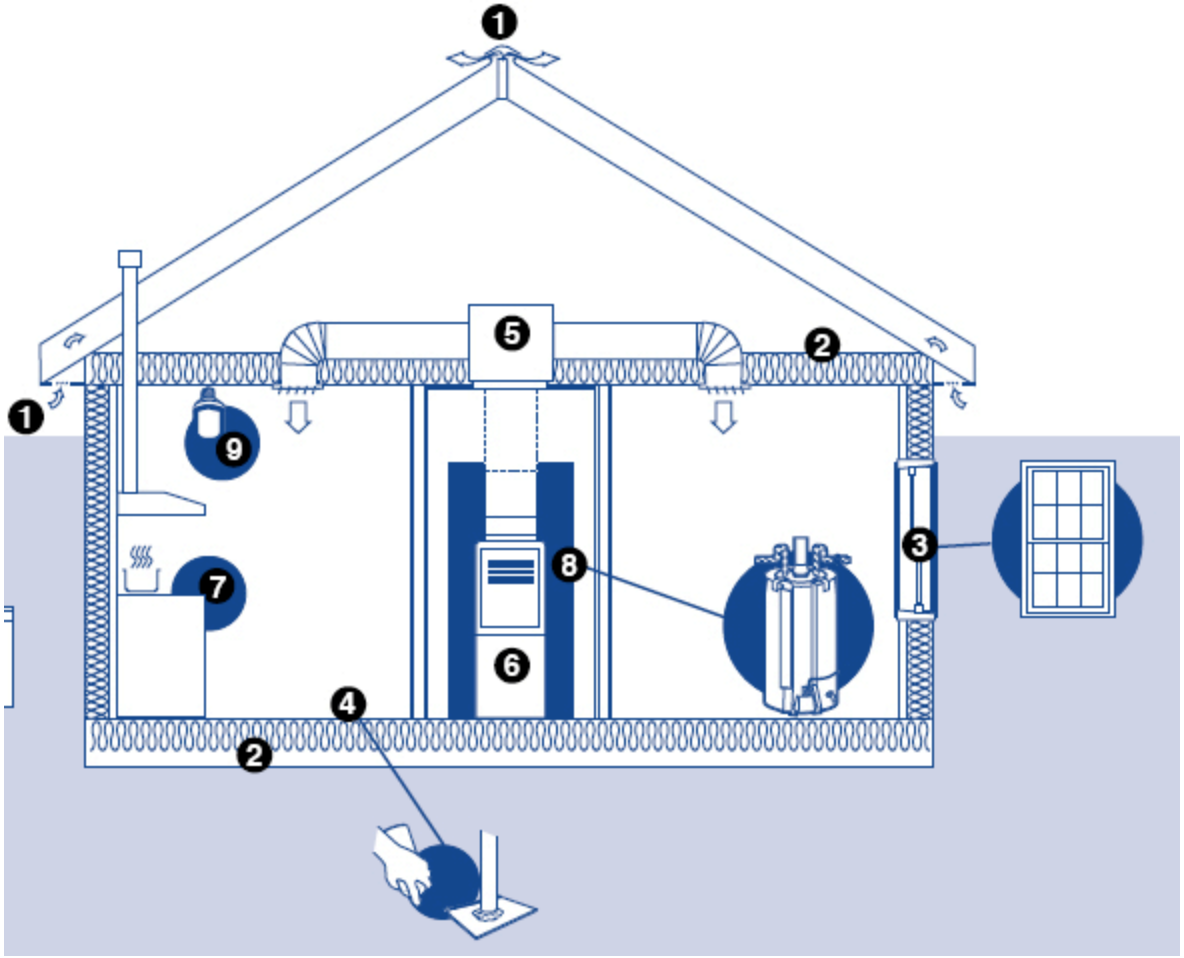
Occupant Behavior and Energy Use

- While comfort is very important, the emphasis here is on energy savings.
- Care should be taken to educate the homeowners as to the impacts of their behavior.



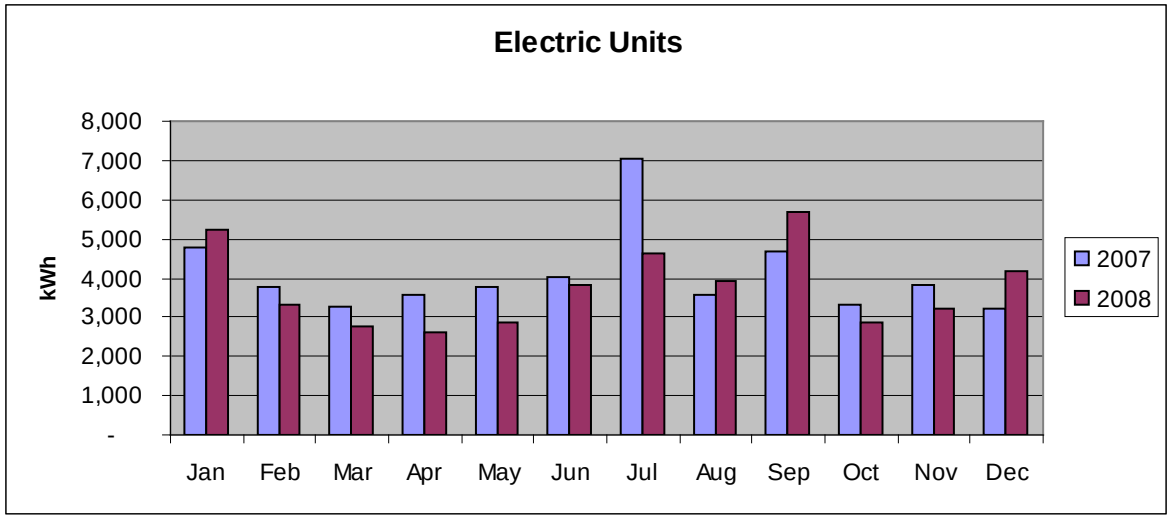
The House as a System

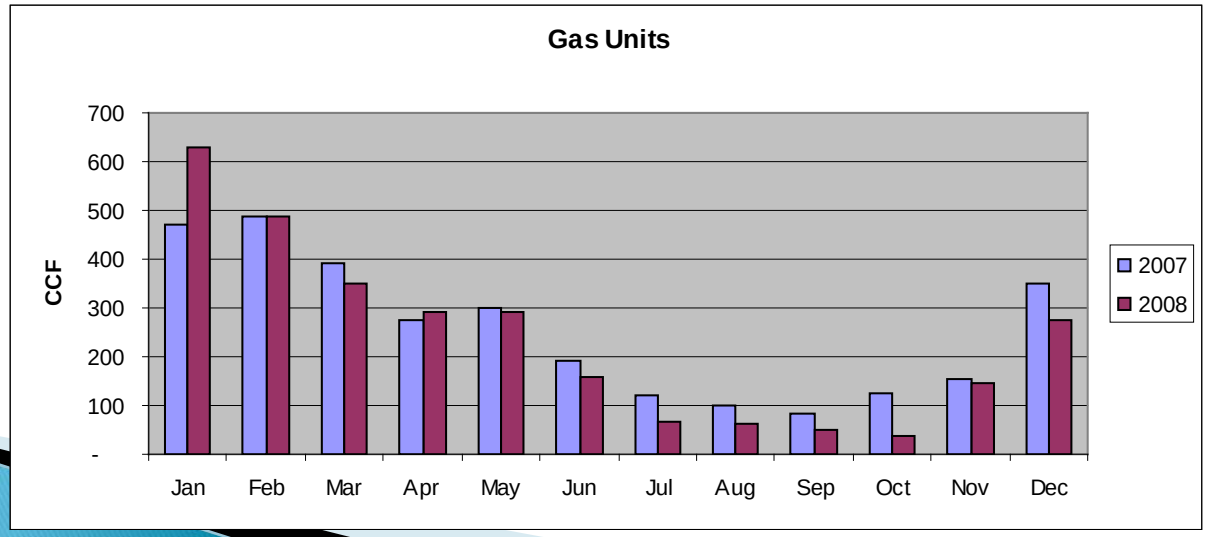
Many Parts make up the Whole



1. Roof ventilation
2. Insulation / Thermal Boundary
3. Fenestration
4. Radon Protection
5. Ducted air distribution system
6. Air Handler / Furnace
7. Appliances
8. Water Heating
9. Lighting

Energy Analysis



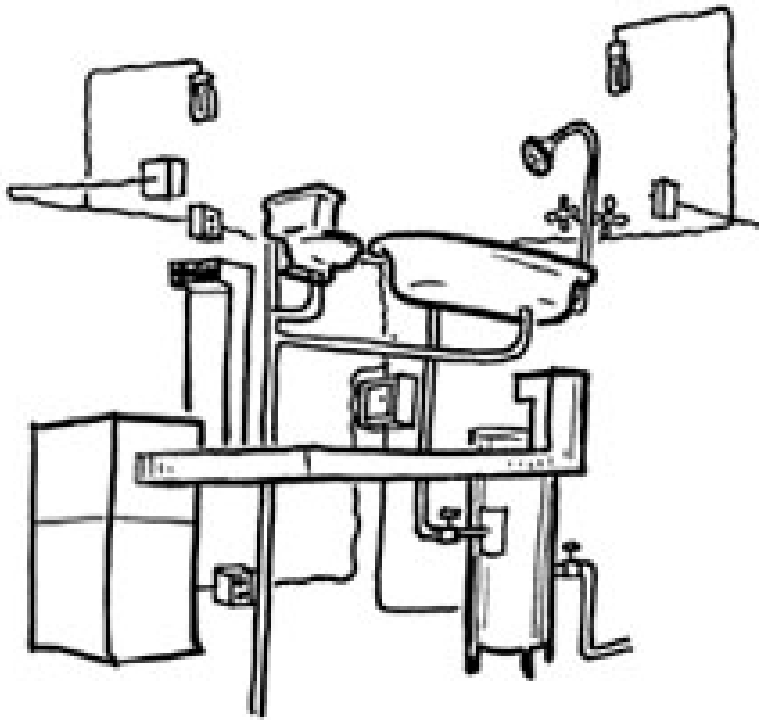


Why Evaluate the House as a System?

- To improve home performance
- To improve living environment
- To make the right recommendations
- To optimize choices

Consider the Interactions Between

- Building envelope
- Heating and cooling
- Landscaping
- Climate
- Homeowner behavior
- Home design



Example of a Systems Evaluation

- An oversized exhaust fan in a kitchen can draw so much air out of the home that it causes the gas fireplace to back-draft, potentially leading to dangerous levels of carbon monoxide.

Key Concepts

- **Evaluate each project as part of a system to**
  - Improve home performance
  - Improve homeowner comfort
  - Avoid making mistakes
  - Decrease risk of litigation
  - Provide best overall value

Loading Order/Scope of Work*

- Envelope
  - Air sealing
  - Roof/attic insulation
  - Wall insulation
  - Floor insulation
  - Cool roof/radiant barrier
  - Windows/Doors
- Heating and Cooling
  - Heating and Cooling equipment replacement
  - Duct sealing and insulation
- Water Heating
  - Water heating equipment replacement
  - Recirculation controls
  - Solar hot water
- Appliances
  - Indoor and outdoor lighting (hardwired)
  - Refrigerators and dishwashers

**Measures based on what can be modeled in HERS II software.*

Cost Effectiveness

Factors that can affect cost effectiveness:

- Energy Savings:
  - Climate
  - Local energy costs (utility rates)
  - Occupant behavior
  - Other work being done to house
  - Subsequent energy measures added to home
  - Actual life of upgraded features

Cost Effectiveness

- Computer software (such as CalRatePro) can be used to help determine cost effectiveness.
- The program calculates the “estimated” energy savings of an energy upgrade (or package of upgrades).
- While these calculations are very precise, they can not predict actual weather or occupant behavior.

Cost Effectiveness

Some features, while cost effective on paper, may not be practical in reality.

- For example:
  - Sealing ducts in a home where most of the ducts are not accessible will not be result in the expected savings.
  - A home with no accessible attic will be difficult, if not impossible to add ceiling insulation to.
- The practicality of the upgrade must be also be assessed by the auditor.
- This will usually be reflected in the bids by the contractors, but it helps to do it up front.

Loading Order

- There are some general rules of thumb for choosing which energy features to do first.
- These are in addition to cost effectiveness evaluation and may sometimes override cost effectiveness in the decision making process.

Loading Order

Safety should always come first.

- Some energy upgrades can create health and safety problems.
  - Reducing infiltration can cause a buildup of indoor air pollutants if ventilation is not adequate.
  - Adding ceiling insulation can sometimes create a fire hazard if there are non-IC rated recessed can lights or exposed wires in the attic.

Loading Order

It is a general rule of thumb that you should improve the shell of the building before you improve the HVAC system.

- It is often the case that improving the shell can dramatically reduce the heating and cooling loads.
- This allows the home owner to install *smaller* equipment while still being more comfortable and using less energy.

Loading Order

Insulation doesn't work if air is moving through or around it.

- Insulation upgrades should always be done in conjunction with air sealing.
- Insulation should always be in good contact with an air barrier, such as drywall.

Loading Order

Duct leakage is a much worse problem than people realize.

- Duct sealing or replacement should always be done whenever HVAC equipment is upgraded.
- In fact, the Title 24 energy codes require this in most climate zones.
- For more information on this requirement, see: http://www.energy.ca.gov/title24/changeout/index.html

Priorities for Energy Efficiency

Very expensive energy upgrades require more careful evaluation.

- More is at stake
- A small percent error in either direction results in a bigger absolute change in cost or savings.
- Sometimes it is better to spend money on several less expensive features than one big, expensive one.

Post Upgrade

Occupant behavior can sometimes change after an energy upgrade has been done.

- This can sometimes negate the energy savings.
- Energy upgrades should always be accompanied by occupant education.

Pre/Post Testing

Diagnostic testing of energy features results in much more accurate assessments of energy savings.

- This includes features that are dependent upon the overall quality of the component in question, such as duct leakage and infiltration

Value-add benefits

By performing diagnostic testing-in and testing-out we verify to ourselves and our clients that improvements have been installed, tested, measured, and verified for:

- Optimized energy savings
- Comfort
- IAQ
- Durability

Additional Homeowner Benefits

- Work with “qualified” professionals
- Get results from investment in multiple areas including:
  - Improved Energy Efficiency
  - Improved Indoor Air Quality
  - More Comfortable Living Environment
  - Enhanced Value of Property
  - Reduce Carbon Footprint
- Receive a Home Energy Efficiency rating that shows how well the home can perform.

The Upgrade Team

- The *Building Science Professional*
- The *Rater*
- The *Contractor*

The Upgrade Team

- The *Building Science Professional*
  - BPI certified to be able to perform audits/assessments on homes for combustion safety, health, IAQ
  - Can/Is brought in as needed for CO testing (during weatherization)
  - Can offer building science input on upgrade opportunities

Building Science Professional

- Typically these individuals have sought out credentials that “prove” their expertise
- It is common for these folks to have multiple credentials including:
  - BPI: B/A, E, H, A/C, MF, ALC
  - HERS: Compliance, WH, BPC Rater
  - CEPE, CEA (Energy Consultant)
  - LEED, GreenPoint Rater
  - Etc.
- Can be utilized in the “Consultant” model to avoid costs associated with trainings and equipment

The Upgrade Team

- The *Rater:*
  - Audits/assesses home for energy upgrade potential
  - Energy modeler (CalRate Pro)
  - Rater (is typically) independent from the contractor
  - Conducts compliance rating/verifications (T24)
  - Provider of building energy score (HERS Score/Rating)

HERS Raters

- The *Rater* :
  - 3rd Party auditor or 'assessor' (Whole House Raters)
  - Energy modeler
  - Third-party verification agent
  - Provider of home energy score
- Rater is independent from the contractor
  - At minimum to perform the post-retrofit verification
  - Contractor may perform assessment if they have met program training requirements (HERS BPC)

Rater Classifications

Compliance Rater –

- Performs field verification and diagnostic testing (FV/DT) for Title 24.
- Assist local code enforcement agencies in enforcing certain parts of the Energy Codes.
- Referred to by Title 20 as a *California Field Verification and Diagnostic Testing Rater*..

Rater Classifications

Whole House Rater –

- This is classification of HERS raters focuses on existing housing stock .
- Gathers information on the energy consuming features of a home,
- Performs diagnostic testing at the home,
- Simulates energy use and
- Performs an analysis for a whole house energy rating or audit.

Rater Classifications

HERS BPC Rater

- A Whole House Rater who works for a Class B General Contactor and who has been certified through an approved BPC program.
- WHR who also has BPI: B/A, E Certifications
- CalCERTS, Inc. is currently the only HERS Provider offering this credential
- Great balance of HERS & Building Science

The Rater:

- Guide the owner to cost-effective, smart, and energy efficient choices
  - Recommend upgrade package
    - Energy and cost analysis
    - Unbiased by contractor's interests
- Assure owner that projected energy savings are realized
  - Energy Assessment Inspection
    - Verify existing home conditions
    - Set accurate baseline for improvements
  - Post-Retrofit Inspection
    - Verification of contractor's work

Rater's Responsibilities

- Post-retrofit verification of all retrofit measures contributing to "x"% improvement over existing conditions
- Verify all measures listed in the 'Notice to Proceed' letter
  - Multiple inspections may be required if one or more of the retrofit measures will be inaccessible at retrofit completion
- Primarily visual inspections
  - Present (installed)
  - Specifications

- Diagnostic testing, as applicable per
  - Retrofit package
  - Title 24 requirements (e.g. HVAC change-out requires duct testing)

Rater's Responsibilities

Upgrade Recommendations:

- Once the building model has been verified, the Rater can begin evaluating energy upgrades.
- They should interview the homeowner carefully regarding what energy upgrades they would consider making.
- What is the overall scope of the renovation of the project? (e.g., will the roof be removed at some point allowing for improvement of ceiling insulation?)

Rater's Responsibilities

Upgrade Recommendations (continued)

- What is the overall scope of the renovation of the project?
  - Will the roof be removed at some point allowing for improvement of ceiling insulation?
  - Will sheet rock or siding be removed at some point allowing for access to the wall insulation and/or ducts?
  - Is replacing windows within the budget?
  - Is replacing HVAC feasible and within budget?
  - Is there room for solar water heating or PV?

California Home Energy Rating Certificate

Information goes here on compliance with other programs:

Qualifying Information Goes Here:

HERS Provider and/or Sponsor Co-Branding Logos Go Here:

Energy Impact

Greenhouse Gas Emissions
Carbon Dioxide xxx tons/year

Energy Consumption

Electricity (kWh/year)	
Cooling	—
Lights	—
Appliances	—
Total	—
Natural Gas (therms/year)	
Space Heating	—
Water Heating	—
Total	—

Operating Cost ($/year)

Electricity	—
Gas	—
Total	—

Renewable Energy Production
None

Ancillary Energy Uses
Swimming pool
Spa
Landscape lighting

Site Information

Address
123 Jones Street
Anywhere, California 9410x

General Information

Conditioned Floor Area	2,200 ft²
Bedrooms	4
House Type	Single Family
Foundation Type	Slab-on-Grade

Energy Efficiency Features

Insulation

Ceiling	R-19
Wall	R-11
Floor over crawlspace	None
Slab Edge	None

Windows

Frame	Aluminum
Glazing	Single

Heating System
Gas furnace, 0.80 AFUE
Unsealed air distribution ducts

Cooling System
None

Water Heating System
Gas storage type, 0.52 EF

Official Home Energy Rating

in conformance with the requirements of the California Energy Commission
www.energy.ca.gov

HERS Provider:
Acme Energy Rated Homes
934 Energy Efficient Way
Power Junction, California
www.AcmeEnergyRatedHomes.com

Rating Information

Rating Number	xxxx-yyyy
Certified Rater	EEH, Inc.
	Stockton, CA
Rating Date:	January dd, yyyy

Rater Signature Date

Upgrade Team

- The *Contractor:*
  - Installs the measures, is hired by the owner
  - May partner with Specialty Trades to complete work
  - May have to subcontract with HERS Rater and/or BPI Professional for additional compliance and CO Safety Testing (if NOT qualified)
  - Can also be the Rater* IF trained as a HERS BPC

*HERS BPC Contractors are NOT allowed to conduct compliance verifications on their own work.

Building Performance Contractors

- GC's who took on energy efficiency, green, building science, community awareness, social responsibility without being asked
- We knew we had a huge impact on the environment and chose to work differently
- Typically self-taught, we traveled around collecting education, knowledge, and certificates.
- Some eventually became BPI (the only game in town) certified.

Business Model Opportunity

- Newly approved HERS BPC Company model
  - One-stop shopping for homeowner
  - Contractor conducts audit (test-in), analysis, installation, verification (test-out, NOT T-24 verifications)
  - Reduce need for outside consultants
  - Regain control of production schedule
- Model
  - Contractor's trained as BPI: Building Analyst AND Envelope OR hire a HERS BPC Rater
  - Contractor's can function as Compliance Rater (for others) and Whole House Raters
  - Contractors submit projects for HERS Score
  - Contractor allowed to test-in, create model, and install features, give rating

Commonality

- All these professionals know the science behind the issues and the importance of comprehensive (whole-house) diagnosis.
- They guide homeowners to solutions that are cost effective and actually work (save money, increase comfort, reduce loads, etc.).
- They can provide “proper measures” and suggest “best practices” for the upgrades specific to the home.

Entering the Whole-House Energy Upgrade Marketplace

- Overview of business models
  - As a Specialty Contractor
  - Become a Building Science Professional
  - Community Partnerships
- Examples
  - General Contractors
  - Production Builders
  - HVAC
  - Insulation
  - Solar

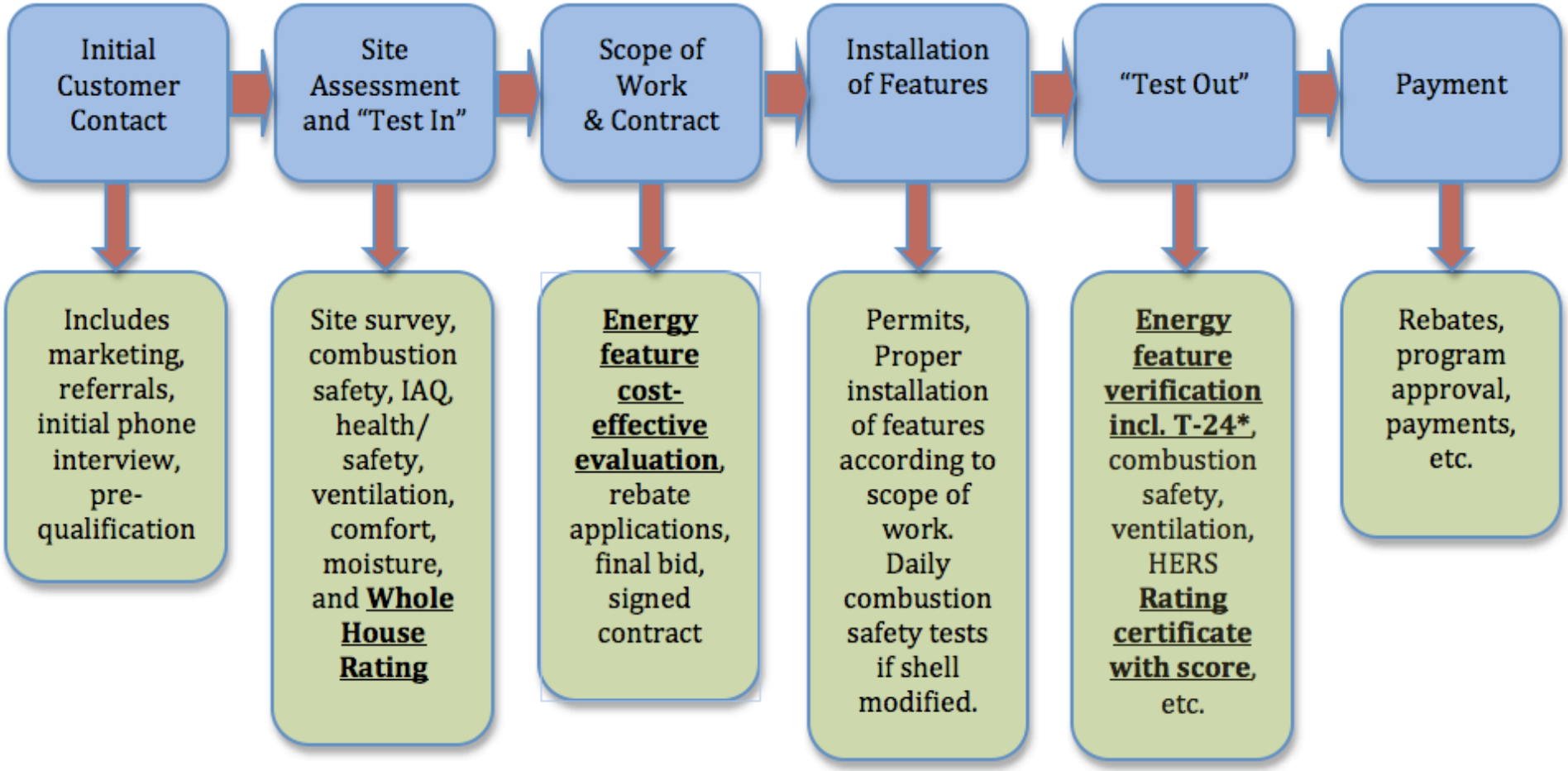
Be careful about merging in…

Energy Upgrade projects are sophisticated and require additional knowledge and skill sets most industry professionals do not possess

- Incentive and rebate programs can be hard to navigate and control
- Additional staff may be required to handle paperwork
- Pairing-up may be the “easiest and safest” approach to entry

Upgrade Project Process Flow

Bold text can be done by an Independent Whole House Rater



* Verification of energy features required by Title 24 due to an HVAC modification can only be done by an independent Rater.

The Responsibilities in a Typical Building Performance Project

Energy Assessment
Test in,
Energy Upgrade Recommendations,
HERS Index (Score),
Test out.

Bldg. Performance Assessment
Test In (Comb. Safety, IAQ, H&S, etc.)
Everything but energy,
Test Out.

Installation
Energy Features and All Other Upgrades and Improvements.

Who does what will vary under different programs. The various options are . . .

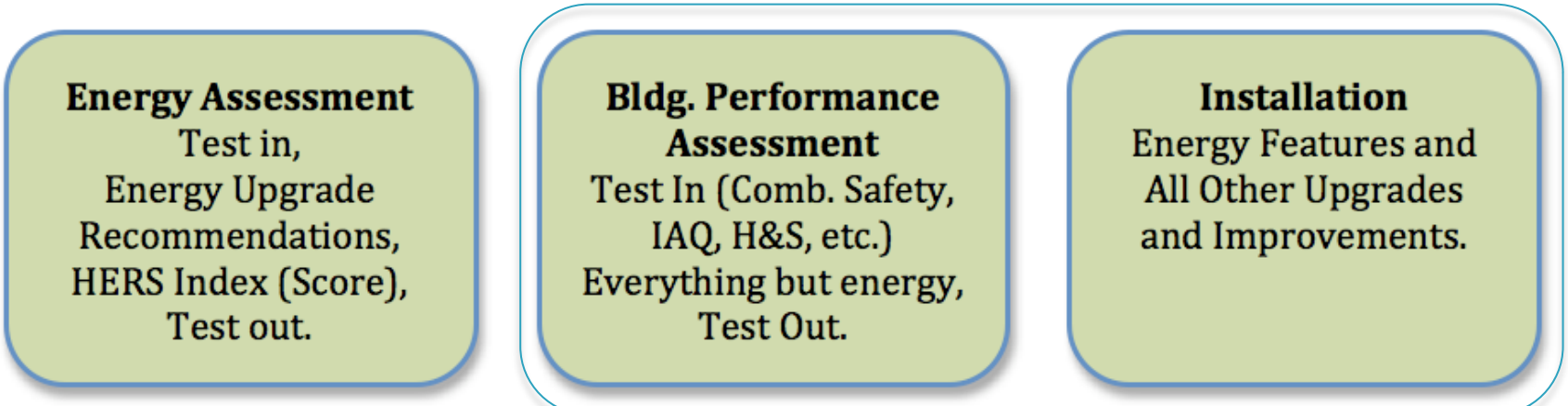
The Responsibilities in a Typical Building Performance Project

Energy Assessment Test in, Energy Upgrade Recommendations, HERS Index (Score), Test out.	**Bldg. Performance Assessment** Test In (Comb. Safety, IAQ, H&S, etc.) Everything but energy, Test Out.	**Installation** Energy Features and All Other Upgrades and Improvements.
Whole House Rater	BPI Certified Building Analyst	Class B General Contractor

Note: Whole House Rater may also perform Title 24 Compliance verification.

Three Separate People

The Responsibilities in a Typical Building Performance Project



Whole House Rater

Contractor with BPI Certifications

Note: Whole House Rater may also perform Title 24 Compliance verification.

Two Separate People

The Responsibilities in a Typical Building Performance Project

Energy Assessment
Test in,
Energy Upgrade Recommendations,
HERS Index (Score),
Test out.

Bldg. Performance Assessment
Test In (Comb. Safety, IAQ, H&S, etc.)
Everything but energy,
Test Out.

Whole House Rater w/BPI Certifications

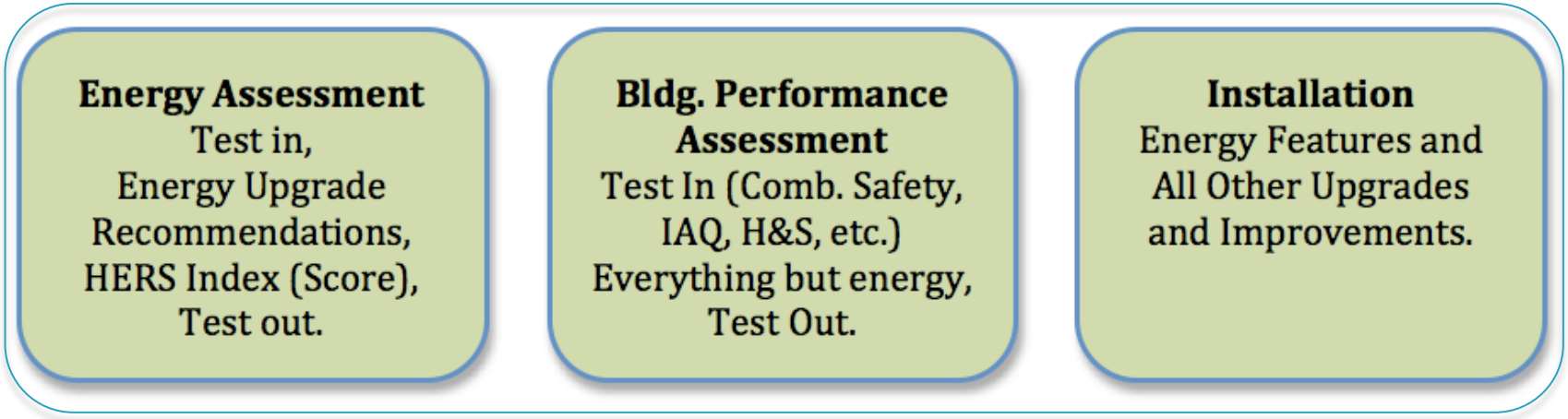
Installation
Energy Features and All Other Upgrades and Improvements.

Class B
General Contractor

Note: Whole House Rater may also perform Title 24 Compliance verification.

Two Separate People

The Responsibilities in a Typical Building Performance Project



HERS Building Performance Contractor

Note: BPC may **NOT** perform Title 24 Compliance verification.

One Single Company

Business Model Options

- Specialty Trade Contractor
  - Examine current credentials and expertise
  - Consider costs associated with additional training and equipment costs
  - Talk with General Contractors you work with and offer an alliance for energy upgrade work
  - If you possess a GC license, consider getting BPI, HERS, GREEN trained to bolster your position as a one-stop-shop

Business Model Options

Expand your current business model to become a Building Science Professional

- If the calendar is light, fill it with training
- There are many sources of ½ day, 1-day, 3-12 day trainings out there full of great stuff
- EVERY architect, builder, remodeler, specialty tradesperson, and supplier should KNOW and UNDERSTAND building science. Get trained & certified!

Where to get Started?

- Industry Training Programs
- Training Subsidies/Scholarship programs
  - (EUC, WIBs/Community Colleges, City & County training programs
- Utility Training Programs
  - PG&E
  - SMUD
- Private Industry Training and Professional Groups
  - CalCERTS
  - BIG
  - Efficiency First
  - NCI

Getting Started

Industry Training Programs

Each trade may have specialized trainings and or certifications:

- HVAC: HVAC Excellence, NATE, EPA, IHACHI, ASHRAE
- Plumbers: GreenPlumbers
- GC's: CGBP, CGB

Getting Started

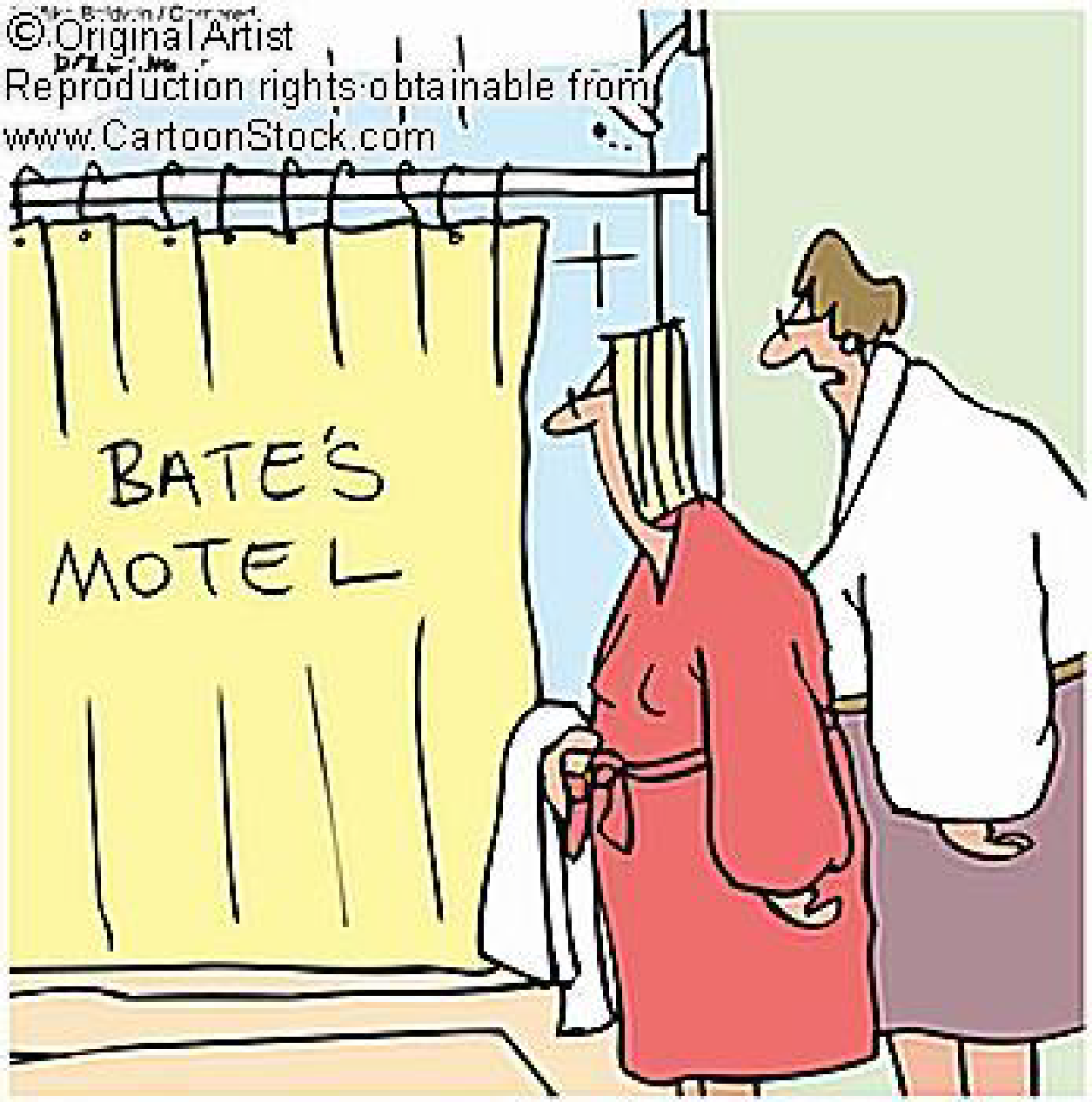
- Training Subsidies/Scholarship programs
  - CEC
  - EUC
  - WIBs
  - Community Colleges
  - City & County training programs

Getting Started

- Utility Training Programs
  - PG&E
    - Many great courses on all kinds of topics
    - Two editions annually
    - Sign up online is easy
  - SMUD
    - Great trainings, mostly around electrical consumption

Getting Started

- Private Industry Training and Professional Groups
  - CalCERTS
    - CA HERS Rater Trainings and Certifications
    - HERS BPC Training and Certification
    - NSHP Training and Certification
    - Energy Star Home
  - BIG
    - CGBP
    - GreenPoint Rater
  - Efficiency First
    - Trade organization
    - Voice of industry?
  - NCI
    - In-depth training on CO, air balancing, etc.



"It's your father's idea. He wants you to take quicker showers."

Questions???

Thank You!

Visit: www.CalCERTS.com for more information on HERS trainings and certifications