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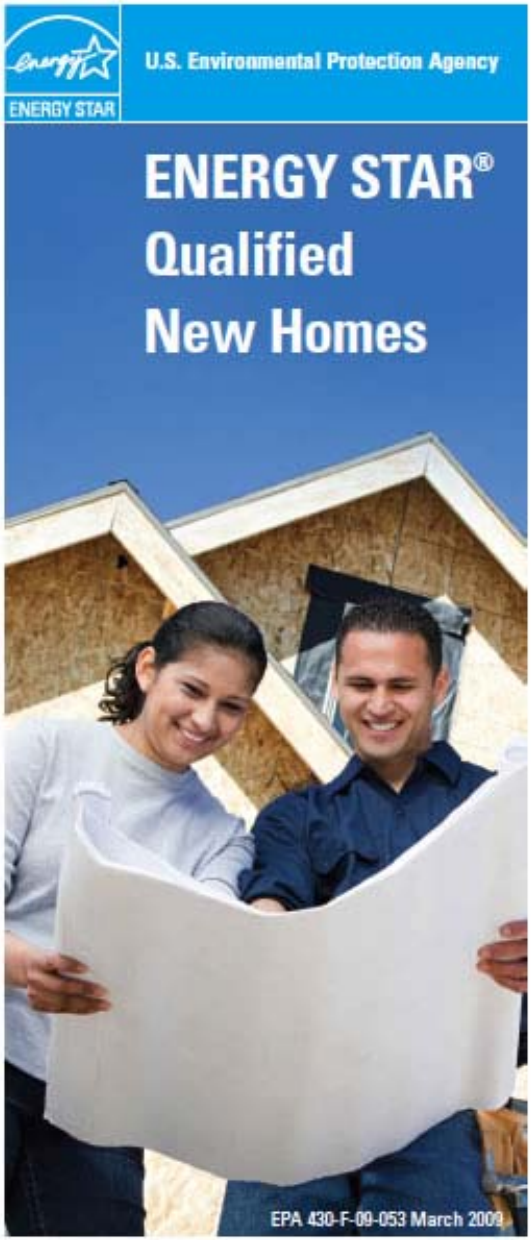
ENERGY STAR

ENERGY STAR VERSION 3

Presented by: Robby Schwarz

What We Will Do?

- Why Energy Star
- The Energy Star Mission
- Prescriptive and Performance path
- Checklists overview
- Marketing



What is Energy Star?

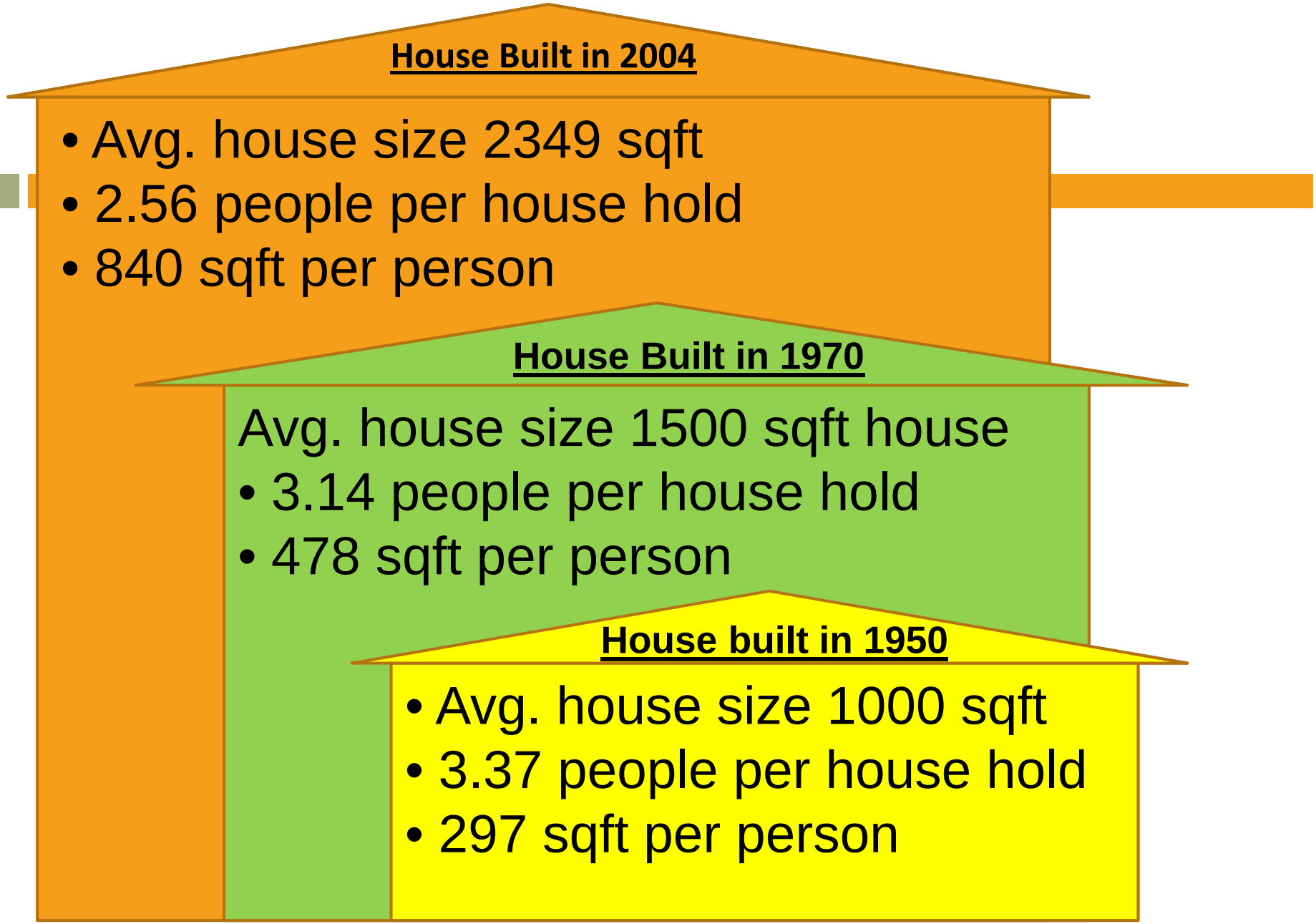
- Energy Star is a joint program of the EPA and the DOE helping us all save money and protect the environment through energy efficient products and practices

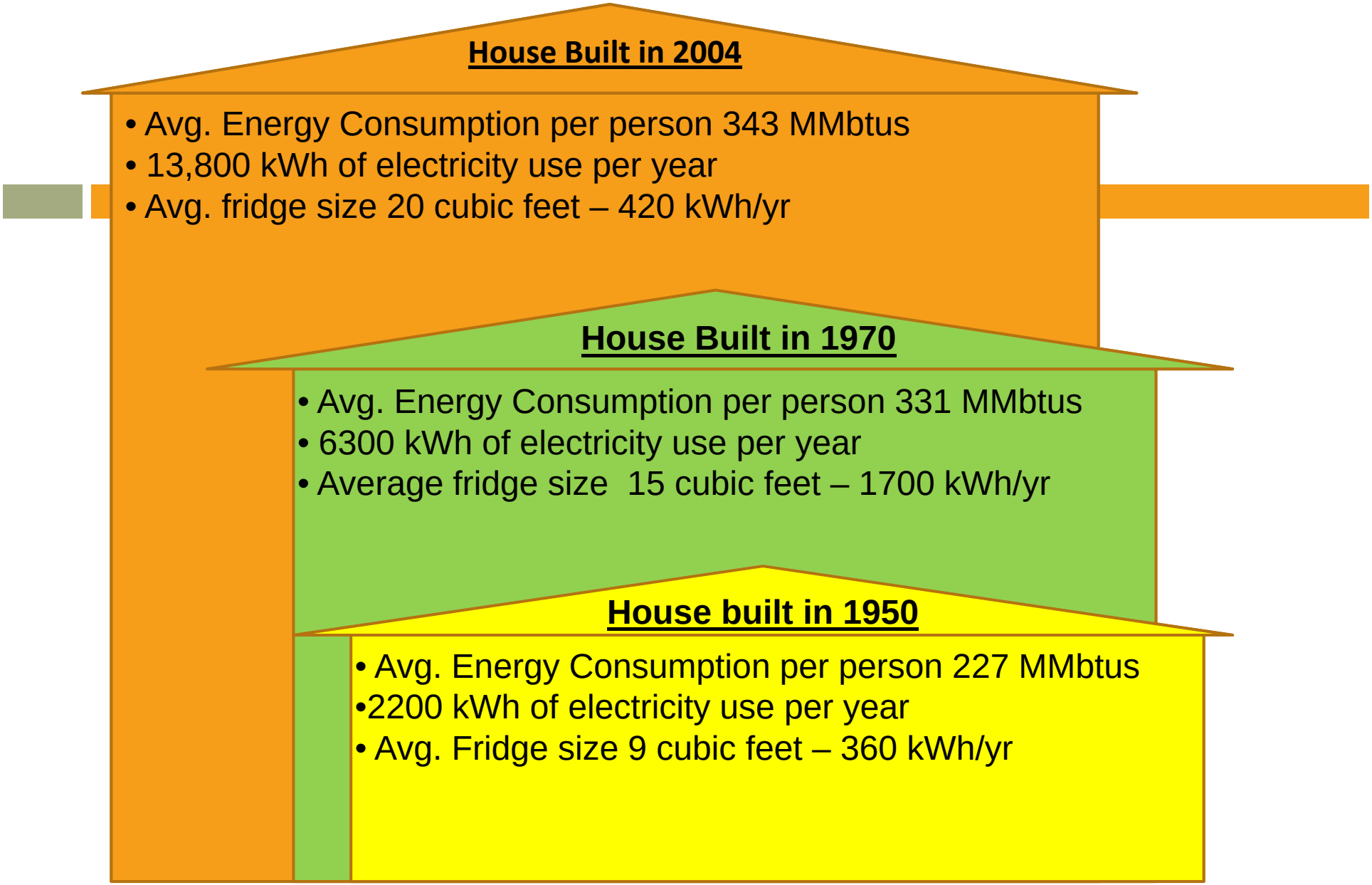
Fundamental Questions

Is It There?

Does It Work?

Look how houses have changed


House Built in 2004
• Avg. house size 2349 sqft
• 2.56 people per house hold
• 840 sqft per person
House Built in 1970
Avg. house size 1500 sqft house
• 3.14 people per house hold
• 478 sqft per person
House built in 1950
• Avg. house size 1000 sqft
• 3.37 people per house hold
• 297 sqft per person


House Built in 2004
• Avg. Energy Consumption per person 343 MMbtus
• 13,800 kWh of electricity use per year
• Avg. fridge size 20 cubic feet – 420 kWh/yr
House Built in 1970
• Avg. Energy Consumption per person 331 MMbtus
• 6300 kWh of electricity use per year
• Average fridge size 15 cubic feet – 1700 kWh/yr
House built in 1950
• Avg. Energy Consumption per person 227 MMbtus
•2200 kWh of electricity use per year
• Avg. Fridge size 9 cubic feet – 360 kWh/yr

The fact is that People buying houses don't know that they want to talk about performance

- Largest Purchase
- Least knowledge

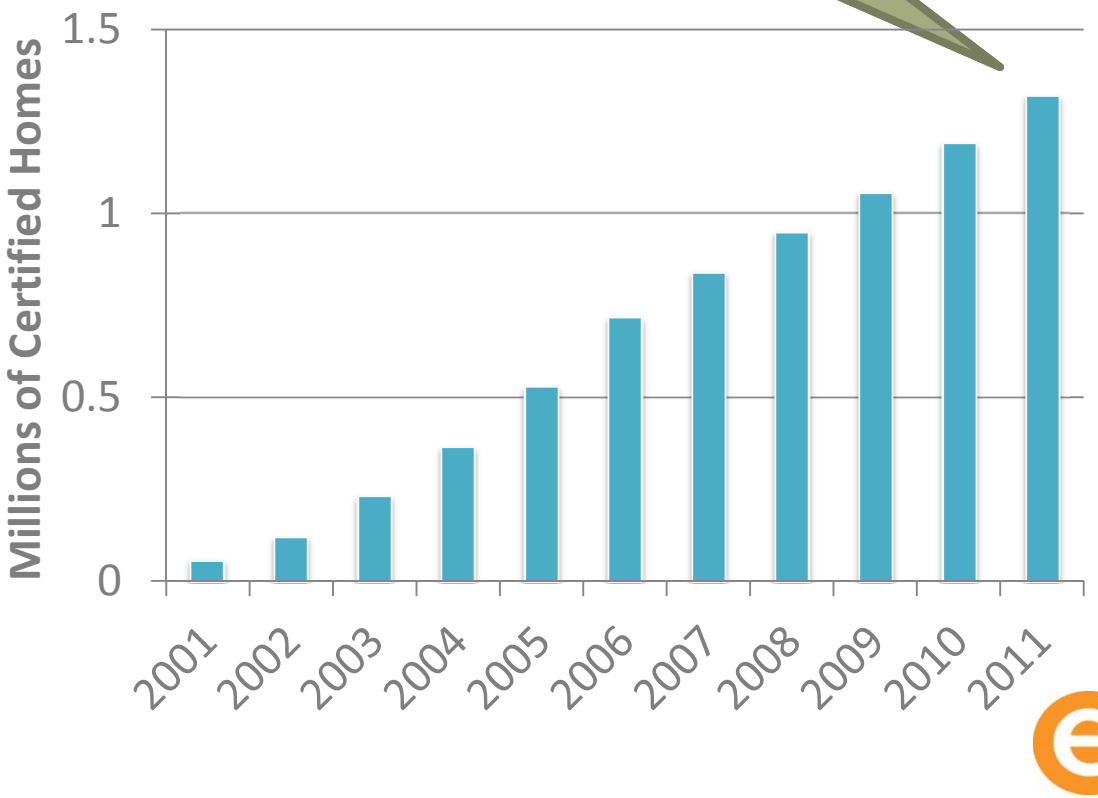
- Phone Performance – A complete system

The Power of ENERGY STAR

- 80% brand recognition
- 92% influence on purchasing

1.3 million homes
> 30% of 2011 new homes

> 4,500 builders

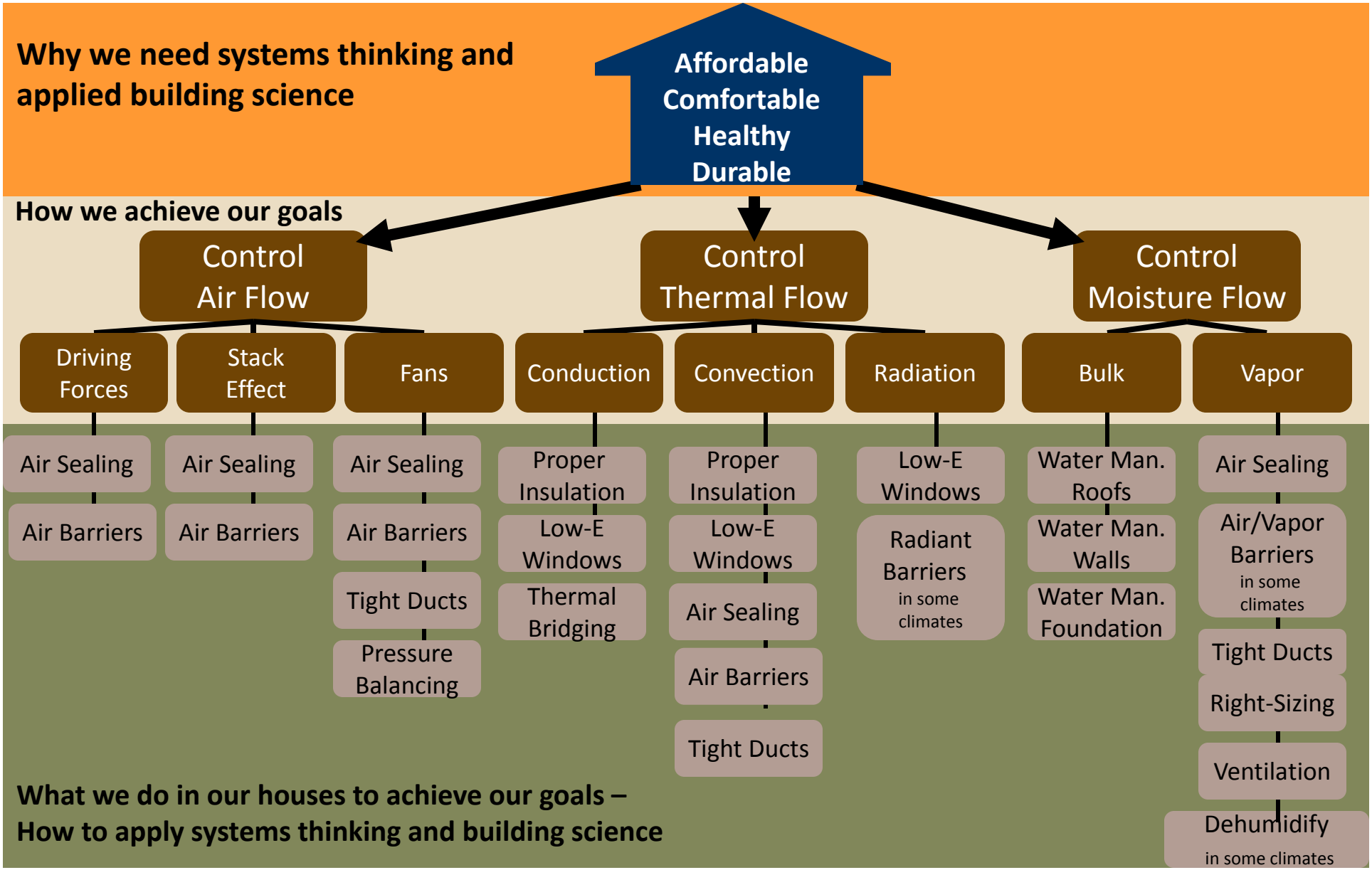


Why the change to Version 3?

- Ensure the delivery of high-quality homes that are meaningfully more efficient than standard new construction
  - Version 2 was to close to the 2006 IECC
  - Maintaining relevance in the market place
- Strengthen the integrity and value of the Energy Star label
- Increasing the success of Raters' and Builders' partnerships with Energy Star

ASK ABOUT ENERGY STAR

PUTTING IT ALL TOGETHER - Control



Systems Integration + Applied Building Science

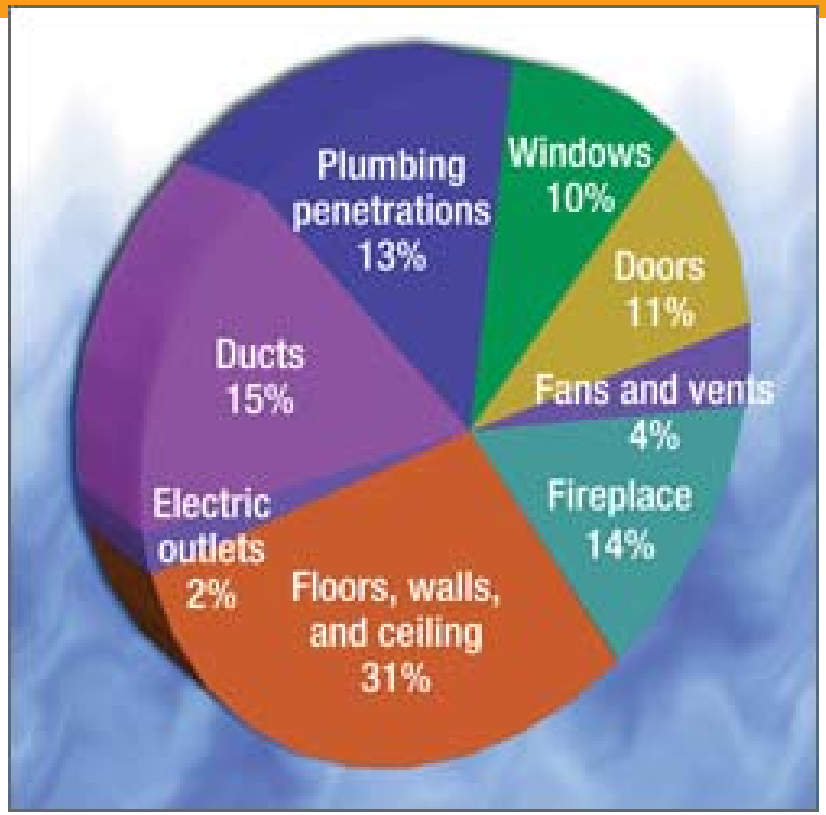
Synergy

- **Two or more things working together to achieve something they could not achieve alone**
  - Man / woman
  - Insulation / air barrier
- Look for the impact
- Logic of the process

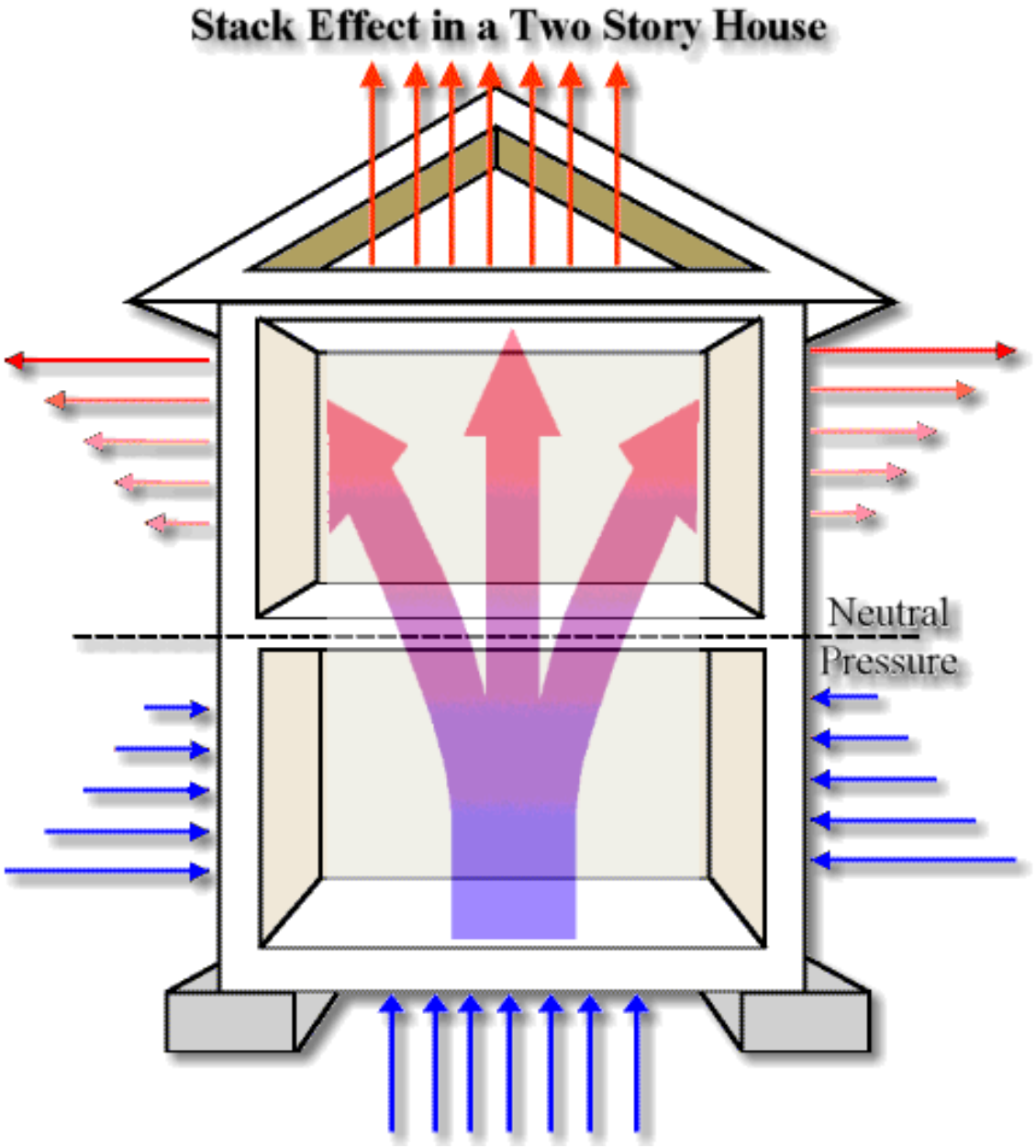
Air Flow

Basic Building Science

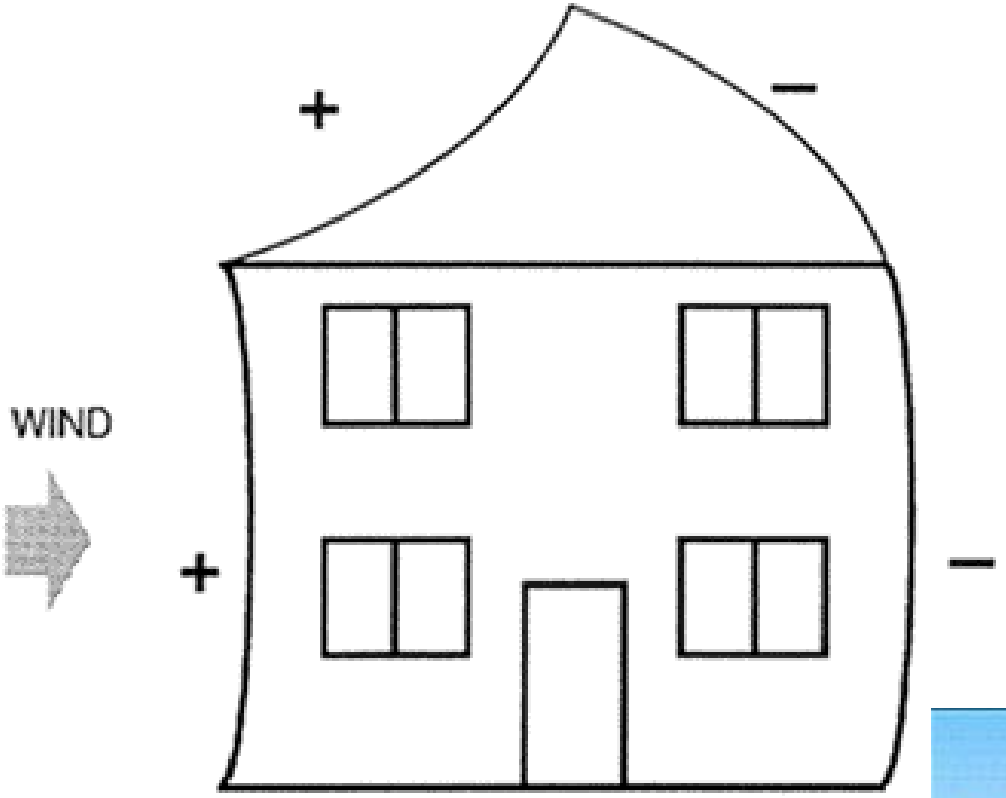
- Air Flow
  - Air is a transport mechanism for heat and moisture
  - Air flow creates + and – pressures in our homes
    - Stack
    - Wind
    - Mechanical

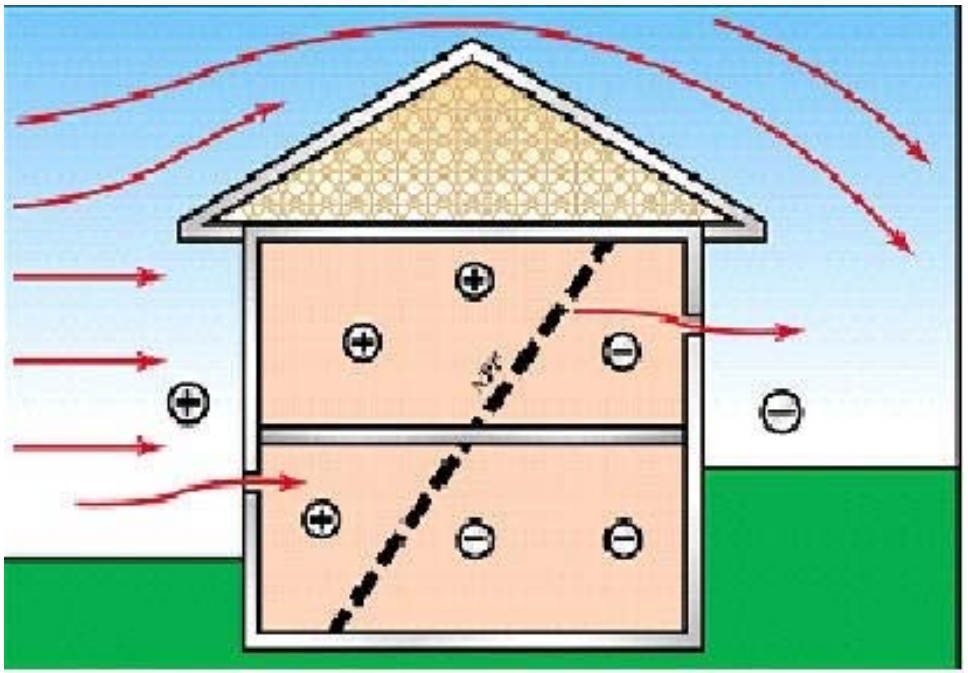


Quick Review
Stack Effect

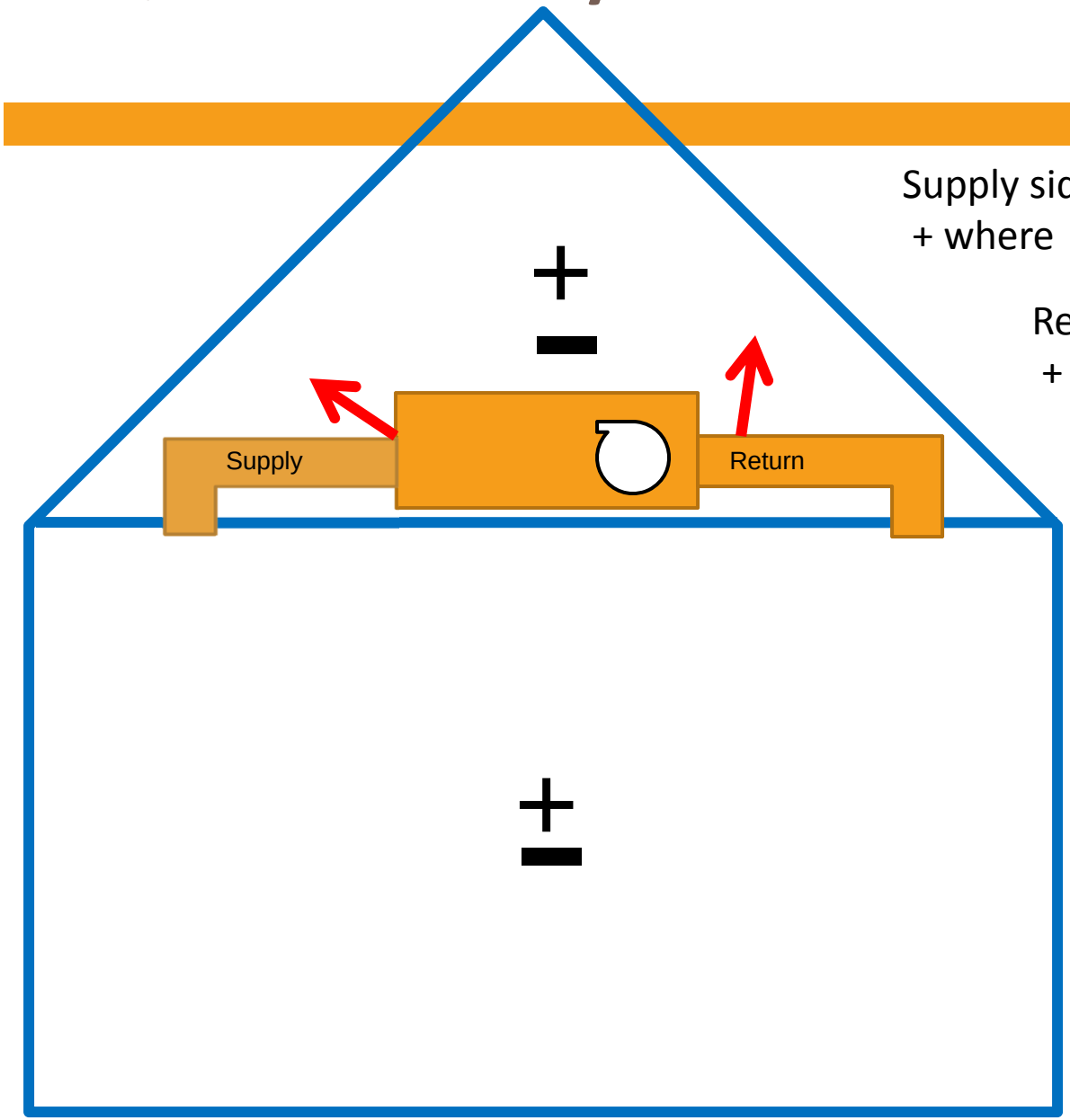


Quick Review
Wind Effect





Quick Review System Effect



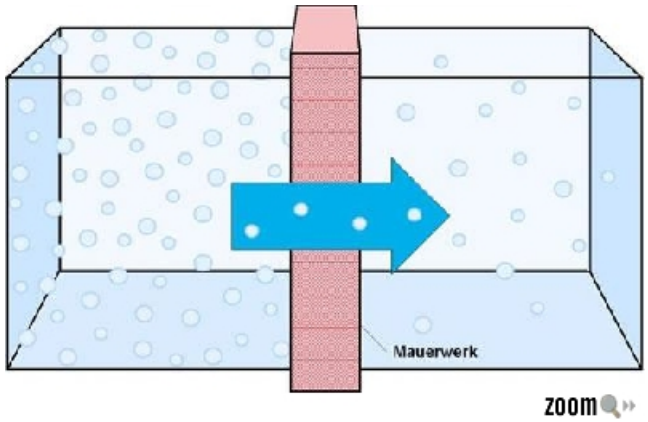
Supply side leak in attic
+ where - where ?

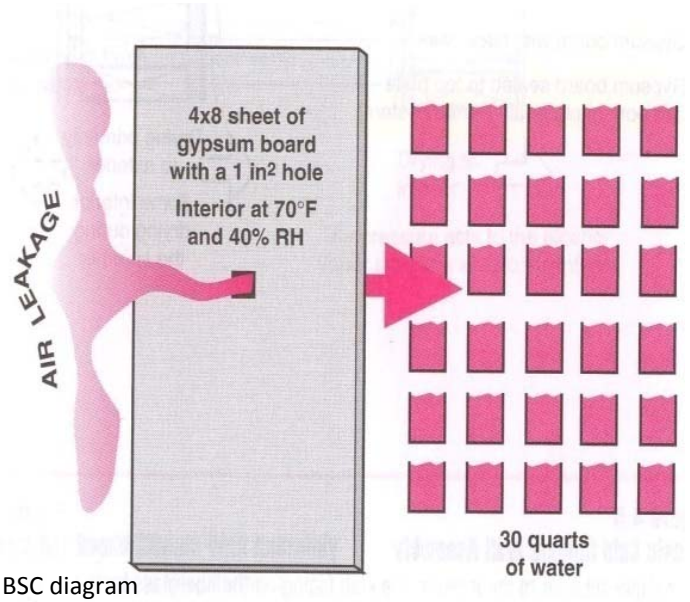
Return side leak in attic
+ where - where ?

Moisture Flow

Basic Building Science

- Bulk water management
- Water vapor management
  - Water Vapor by itself moves through materials by Diffusion
    - A slow and Small process
    - Water vapor migrates from more to less
  - Water Vapor is carried by air
    - A large and fast process



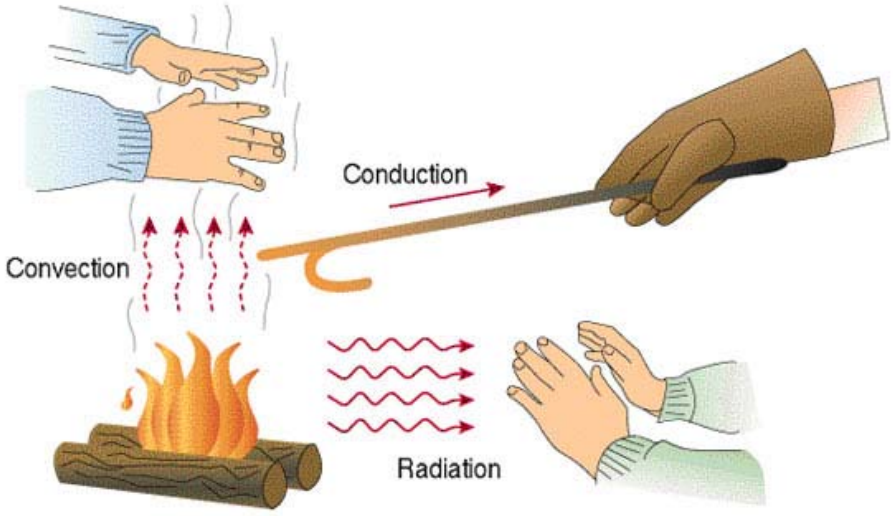


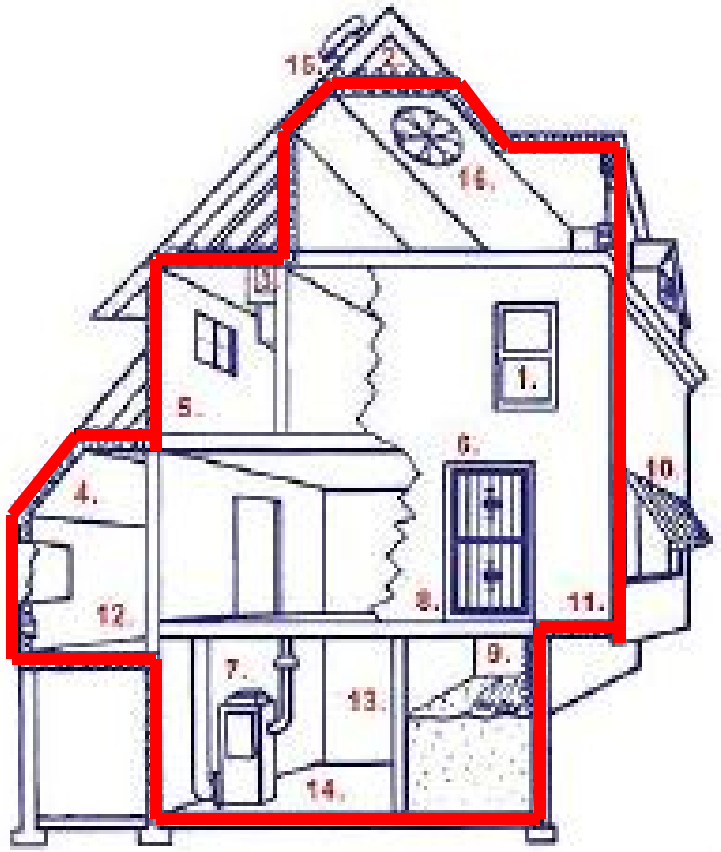
BSC diagram

Thermal Flow

Basic Building Science

- Basic Building Science
  - Thermal Flow
    - Define the thermal boundary
    - How systems work to control Conditioned air
      - Heat and Moisture





Understand

- We are no longer true “builders”
- Understand building science and how things perform
- Leaders of change and innovation
  - Design – construct – test – review – learn
- Educate our trade partners
  - Systems thinking and applied building science
  - **Air flow**
  - **Thermal flow**
  - **Vapor flow**
- Inform the trades of our objectives

1995 Energy Star program

- Air Flow
  - Air sealing – Tight Ducts
- Thermal Flow
  - Air Sealing – Tight Ducts – Low-E Windows
- Moisture Flow
  - Air Sealing – Tight Ducts
- Additional features
  - HVAC Efficiency - Loads
  - 3rd party verification

2006 Energy Star Program and the TBC

- Air Flow
  - Air sealing – Tight Ducts
  - Air Barriers
- Thermal Flow
  - Air Sealing – Tight Ducts – Low-E Windows
  - Air Barriers – Insulation alignment
- Moisture Flow
  - Air Sealing – Tight Ducts
  - Air Barriers – Right Sizing HVAC equipment
- Additional features
  - HVAC Efficiency – Loads - 3rd party verification
  - Lighting and Appliances

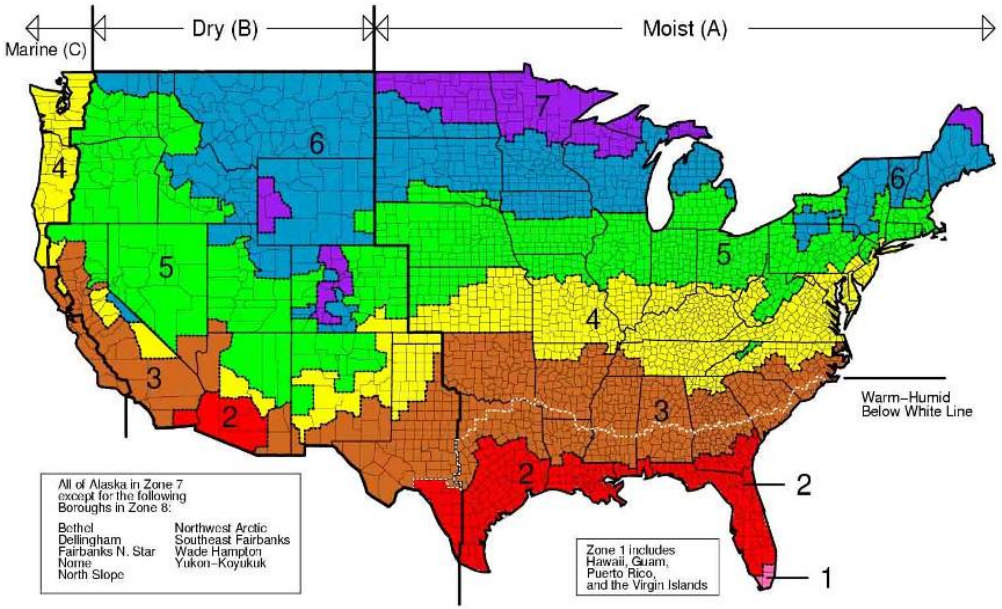
Version 3 / 2011 Energy Star Program

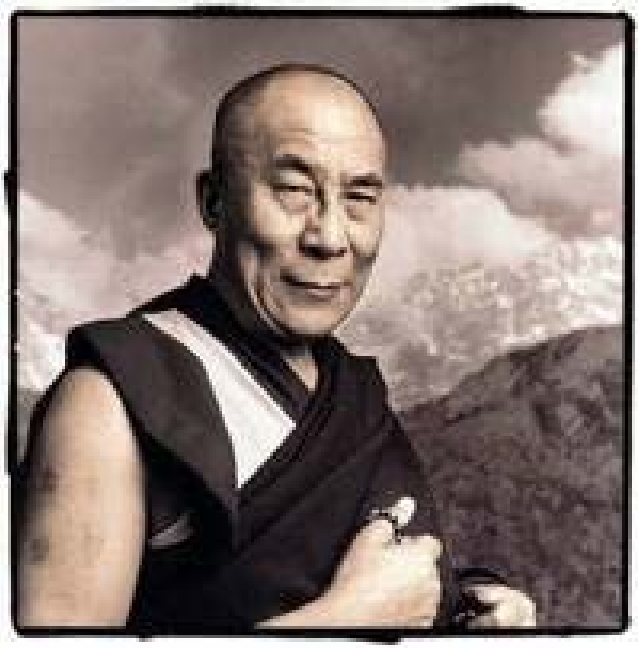
- Air Flow
  - Air sealing – Tight Ducts - Air Barriers
  - Pressure Balancing
- Thermal Flow
  - Air Sealing – Tight Ducts – Low-E Windows - Air Barriers -Insulation alignment
  - Insulation Installation – Minimize thermal bridging
- Moisture Flow
  - Air Sealing – Tight Ducts - Air Barriers – Right Sizing HVAC equipment
  - Ventilation – climate specific de-humidification – Water management construction
- Additional features
  - HVAC Efficiency – Loads - 3rd party verification - Lights and Appliances
  - HVAC Quality Installation - commissioning

Energy Star V3

“Learn the rules so you know how to break them properly”

- Author: Dalai Lama
  Date: Feb 25, 2008





ESv3 Compliance: Similar to Code Compliance

Like for energy code compliance there is a:

- Prescriptive path and a Performance path
- For Code
  - Prescriptive path: Prescriptive R-values and U-values
  - Performance path: Trade offs of R-values and U-values
    - UA Trade off – ResCheck
    - Simulated performance path
  - Mandatory aspects of code:
    - Air barriers, Insulation installation, Performance testing, etc.

Mandatory Aspect of ESv3

Mandatory Measures detailed out in the four checklists

- Every item on a checklist that is pertinent to the house being labeled is Mandatory
- Four Checklists
  - Thermal Enclosure
  - HVAC Contractor
  - HVAC Rater
  - Water Management

ESv3 – The Houses Base Efficiency

Prescriptive Path

- Must show eligibility:
  - Only eligible for homes ≤ the Benchmark conditioned floor area (CFA)
- If CFA House is > BHS
  - Must use performance path
- Must use the Energy Star Reference Design
  - **ES Specifications**
  - **NO tradeoffs allowed**
  - **NO modeling**

or

Performance Path

- No longer using HERS 85 as the target
- Develops a house specific Energy Star HERS target index score
  - This is the highest HERS Index that a home can achieve to qualify as Energy Star
- Possible Size Adjustment
- House must be ≤ ESv3 reference home HERS index target to

Exhibit 1: Benchmark Home Size[1,2]

Bedrooms in Home to be Built	1	2	3	4	5	6	7	8
Conditioned Floor Area Benchmark Home	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

Prescriptive and Performance

- Energy Star V3 is based on slightly modified 2009 IECC insulation levels
- And insulation must meet or exceed the 2009 IECC
  - Achieve Grade 1 installation per the RESNET Standards
  - Grade 2 is allowed if **only if** exterior rigid insulated sheathing is used
- Duct Leakage Testing

ESv3 Prescriptive Path

- A single set of measures (specifications) used to construct ENERGY STAR qualified homes
- You must use the Energy Star Reference Design
  - What is a Reference Design?
    - The design features you must use
    - The Specification
    - **A standard set of house specifications that generate a specific level of <u>quantifiable</u> energy performance**
  - Remember the house must qualify to use the

Exhibit 1: Benchmark Home Size[1,2]

Bedrooms in Home to be Built	1	2	3	4	5	6	7	8
Conditioned Floor Area Benchmark Home	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

Additional Prescriptive Path Requirements

- A Rater must verify all Mandatory Requirements for All Qualified Homes
- Energy Star qualified windows
  - Homes with total window-to-floor area greater than 15% shall have adjusted U-values or SHGCs ……
- Energy Star qualified heating and cooling equipment
- Water Heater efficiency adjustment
- Energy Star qualified appliances
- Energy Star qualified exhaust fans
- 80% Energy Star qualified lighting or fixtures
- Less Flexibility

2009 IECC Prescriptive Table

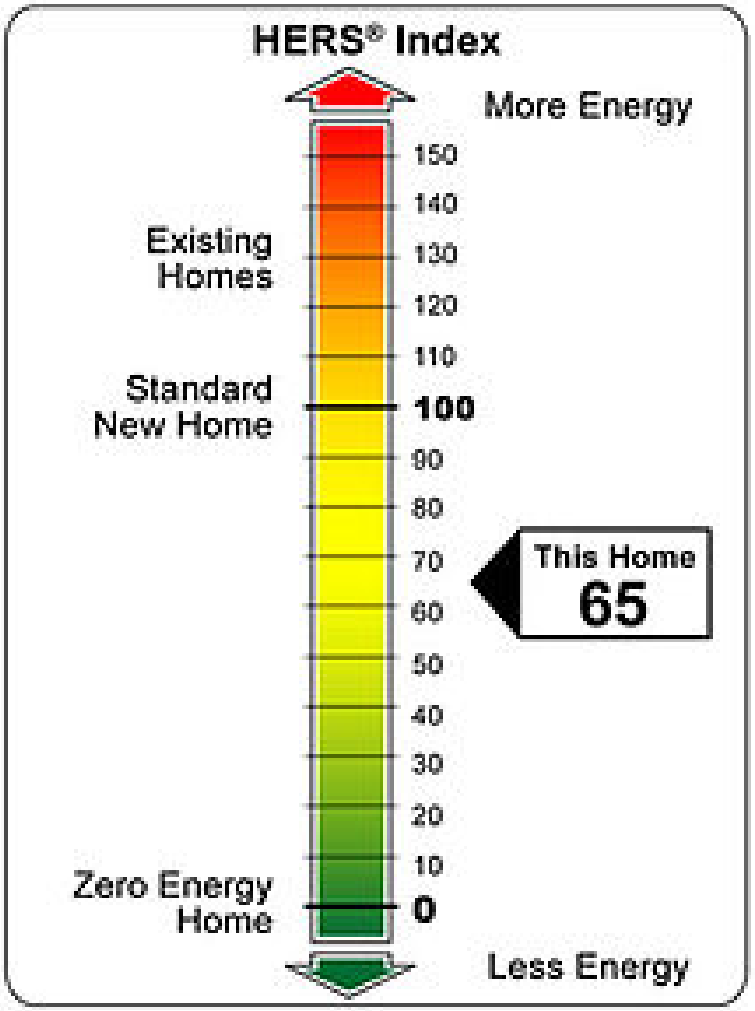
Window, Skylights, & Doors Must be Energy Star Qualified

Package	Window U-Factor – Energy Star	Skylight U-Factor – Energy Star	Energy Star Door	Ceiling R-Value	Wood Framed Wall R-Value	Mass Wall R-Value	Floor R-Value	Basement Wall R-Value	Slab R-Value and Depth	Crawl Space Wall R-Value
Climate Zone 4	0.35 / 0.30	0.60 / 0.55	Opaque area R - 4.76 ≤ ½ lite U-.27 SHGC .30 ≥ ½ lite U-.32 SHGC .30	R-38	R-13	R-5/10	R-19	R-10/13	R-10, 2ft	R-10/13
Climate Zone 5	0.35 / 0.30	0.60 / 0.55	Opaque area R - 4.76 ≤ ½ lite U-.27 SHGC .30 ≥ ½ lite U-.32 SHGC .30	R-38	R-20 or 13+5	R-13/17	R-30	R-10/13	R-10, 2ft	R-10/13
Climate Zone 6	0.35 / 0.30	0.60 / 0.55	Opaque area R - 4.76 ≤ ½ lite U-.27 SHGC .30 ≥ ½ lite U-.32 SHGC .30	R-49	R-20 or 13+5	R-15/19	R-30	R-15/19	R-10, 4ft	R-10/13
Climate Zone 7 &8	0.35 / 0.30	0.60 / 0.55	Opaque area R - 4.76 ≤ ½ lite U-.27 SHGC .30 ≥ ½ lite U-.32 SHGC .30	R-49	R-21	R-19/21	R-38	R-15/19	R-10, 4ft	R-10/13

Energy Star's Performance Path

- Homes that do not qualify for the prescriptive path
- For those Builders choosing to use it
- Provides more **flexibility**
- Still requires the mandatory checklists

Performance Path



- Models a homes energy performance
- Compares it to the Energy Star Reference design
- Develops a house specific Energy Star HERS target index score
  - This is the highest HERS Index that a home can achieve to qualify as Energy Star

The Reference Home/Twin Home Concept Used by **modeling software for Code**

2012 reference design house Built from table 405.5.2(1)

vs.

Rated Home: Builders desired house

- The reference home is the **geometric twin** of the rated home ***configured to a standard set of thermal performance characteristics***:
- I.e. The 2012 IECC Prescriptive path specification

- The home you are building and evaluating, compared to the "Reference" home in order to quantify performance and demonstrate compliance with the Energy code.

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2012 IECC ANNUAL ENERGY COST COMPLIANCE

Date: February 01, 2012 Rating No.: 16805

This home MEETS the annual energy cost requirements and verifications of Section 405 of the 2012 International Energy Conservation Code based on a climate zone of 5B. In fact, this home surpasses the requirements by 14.4%.

Duct Leakage (Section 403.2.2): PASSES

This home MEETS the annual energy cost requirements and verifications of Section 405 of the 2012 International Energy Conservation Code based on a climate zone of 5B. In fact, this home surpasses the requirements by 14.4%.

Name: Robby Schwarz Signature:

Organization: EnergyLogic Inc. Date: February 01, 2012

Twin House Software Modeling ESv3

ESv3 Reference Design based on the 2009 IECC

- Geometric Twin
- Energy Star V3 reference design house (based on 2009 IECC)

vs.

Builder's desired house

- Geometric Twin
- Envelope U-Values based on Builder's Specification

Builder's house is compared to the Energy Star V3 Reference Design to create a HERS Target Index Score. The house must be ≤ the modeled HERS Index score

Determining the HERS Index Target

- Using the Energy Star Reference Design

- Example:
  - 3602 total SQFT in house
  - 1216 sqft is basement (no bedrooms in basement)
  - 3 bedrooms
  - Energy Star reference home HERS Index 70
  - Size adjustment needed based on CFA Benchmark Home

Size adjustment

Exhibit 1: Benchmark Home Size[1,2]

Bedrooms in Home to be Built	1	2	3	4	5	6	7	8
Conditioned Floor Area Benchmark Home	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

- The size adjustment factor cannot exceed 1
  - Therefore it only modifies the HERS Index requirement for houses with conditioned floor area greater than the Benchmark Home
  - Floor area in basements shall not be counted for the purpose of determining a home's Benchmark Home Size and Size Adjustment Factor
    - **If at least half of the basement's wall area is below grade**
  - (NEW) All bedrooms, regardless of location, are included for the purpose of determining the homes Benchmark home size and adjustment

Walkouts and Garden Level Basements

Size adjustment

Exhibit 1: Benchmark Home Size[1,2]

Bedrooms in Home to be Built	1	2	3	4	5	6	7	8
Conditioned Floor Area Benchmark Home	1,000	1,600	2,200	2,800	3,400	4,000	4,600	5,200

$$SAF = (CFA_{\text{benchmark home}} / CFA_{\text{Rated home}})^{0.25}$$

3602 – 1216= 2386

$SAF = (2200/2386) = 0.922^{0.25} = 0.98$

Energy Star reference home HERS Index 70

70 x .98 = 68

New Energy Star reference home HERS Index **68**

Actual Final HERS Index was 63

Using REM Modeling

New REM Report

REM/Rate™

The Energy Star Home Report

Normalized, Modified End-Use Loads (MMBtu/year)

	ENERGY STAR	*As Designed*
Heating:	32.4	50.4
Cooling:	13.1	9.6
Water heating:	11.0	10.9
Lighting & Appliances:	41.7	63.6
Total:	98.2	134.5

HERS Index of Reference Design Home	**65**	**90**	**HERS Index w/o PV**
HERS Index Target (SAF Adjusted)	**65**	**90**	**HERS Index**
Size Adjustment Factor:	**1.00**		

HERS Index w/o PV <= HERS Index of Reference Design Home AND HERS Index <= HERS Index Target to comply.

Mandatory Requirements for All ENERGY STAR Version 2.5 Qualified Homes

- [X] Duct leakage to outside < 6 CFM25 per 100 sq.ft. of conditioned floor area.
- [ ] Envelope insulation levels meet or exceed 2009 IECC levels. (Not Required for Version 2.5!)
- [X] Slab on Grade Insulation > R-5 at IECC 2009 Depth, Climate Zones 4 & above. (Not Required for Version 2.5!)
- [X] Insulation achieves RESNET Grade I installation or Grade II for walls. (Not Required for Version 2.5!)
- [X] Windows meet the 2009 IECC Requirements - Table 402.1.1. (Not Required for Version 2.5!)
- [X] Duct insulation meets the EPA minimum requirements of R-6. (Not Required for Version 2.5!)
- [ ] Mechanical ventilation rate is within 100-120% of ASHRAE 62.2-2007 values. (Not Required for Version 2.5!)
- [ ] ENERGY STAR Checklists verified and complete. (Not Required for Version 2.5!)

This home DOES NOT MEET the energy efficiency requirements for designation as an EPA ENERGY STAR Version 2.5 Qualified Home.

In This Case

Version 3

80
- Move from supply ventilation to exhaust -10 HERS Index point

72
- Add foundation insulation -8 HERS Index points

69
- Infiltration from .28 to.20 NACH -3 HERS Index points

64
- 100% CFL's -5 HERS Index points

- Version 3 add thermal Bridging requirment

House Specs

- Foundation R-11
- Slab R-0
- Floor Blown R-43
- Rim R-19
- Walls blown R-23
- Windows U-35/SHGC.36
- Doors R-5/ R-2.2
- Attic R-38
- Furnace 92.1 AFUE w/ 100 CFM LTO
- Water Heater 62 EF
- AC 13 Seer
- 0.20 NACH & Ventilation
- Default appliances 100% CFL

Mandatory Checklist Requirements

- House must conform with all relevant items on the checklists
- Verification by a Rater is required for both Prescriptive and Performance pathways
- Overlapping requirements (Code)
  - If code is more stringent or there is a conflict with code
- Alternative methods of achieving checklist items
- Builder sign off at the discretion of the Rater
- Documentation requirement
- IAP can replace the Water Management Checklist

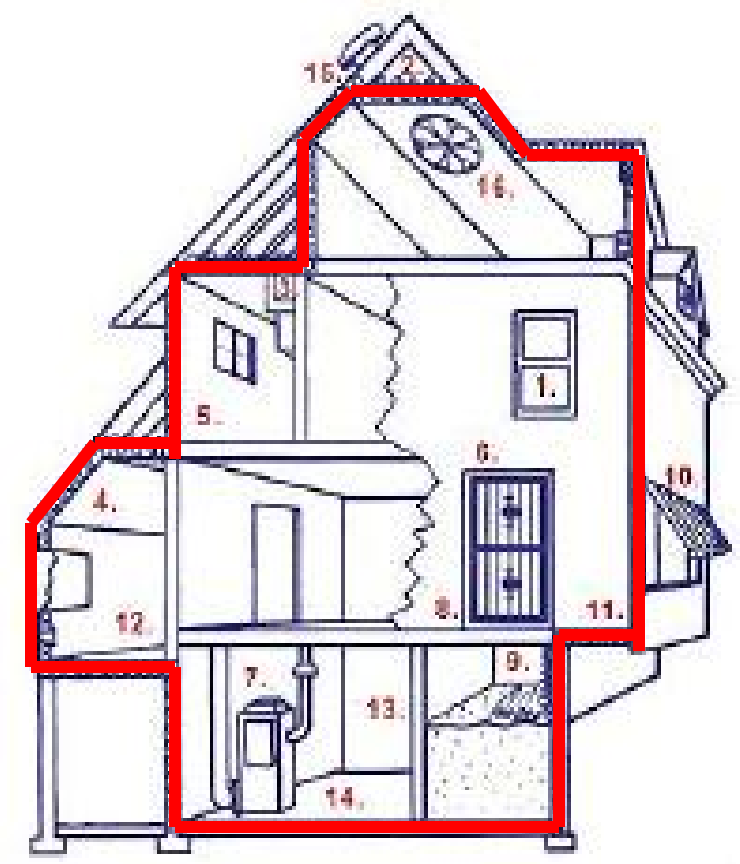
What's in ENERGY STAR?

Core Energy Efficiency Features

Thermal Enclosure System Checklist	High-quality insulation & fenestration Proper installation & air sealing Reduced thermal bridging
HVAC Contractor and Rater Checklists	Fully-engineered design Best practice installation Fresh air & exhaust
Water Management System Checklist	Water-managed site, foundation, walls, and roof

Thermal Enclosure Systems Rater Checklist

- Air Barrier and insulation alignment
- Insulation installation
- Reduced thermal bridging
- Air sealing



Energy Star - Air Barrier

- For purposes of this checklist, an air barrier is defined as:
  - Any durable solid material
  - That blocks air flow between conditioned space and unconditioned space
  - Including necessary sealing to block excessive air flow at edges and seams
  - EPA recommends, but does not require, rigid air barriers
  - If flexible air barriers are used, they shall be fully sealed at all seams and edges and supported using fasteners with caps or heads ≥ 1 in.
  - Flexible air barriers shall not be made of kraft paper, paper-based products, or other materials that are easily torn
  - If polyethylene is used, (**Not recommended**) its thickness shall be ≥ 6mil.

5 key Air Barriers Attributes

- **Continuity**: The most important element in 3D structures with so many different components
- **Strength**: The ABS must be designed to transfer the full designed wind load and continue to be impermeable
- **Durability**: The ABS must continue to be impermeable throughout its service life
- **Stiffness**: The ABS must be stiff enough so that irregularities do not change its permeance
- **Impermeability**: The ABS must be impermeable to Air

Insulation

Insulation traps pockets of air

Stagnate Air Pockets create the R-value

Air Barrier

Stopping the movement of air from scrubbing away the stagnate air pocket

Now it works

CONTROLLING THERMAL FLOW

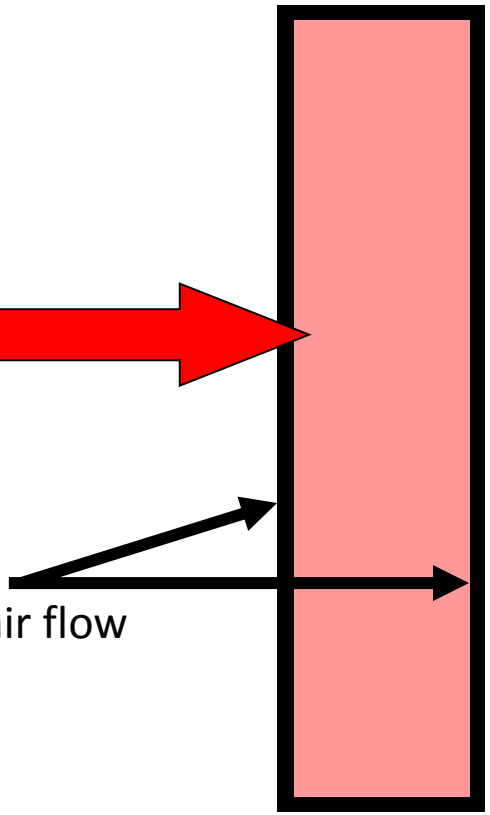
Most insulation

is NOT an air barrier*

Resists Conduction

Does not resist Air Flow:

That is the job of the air barrier

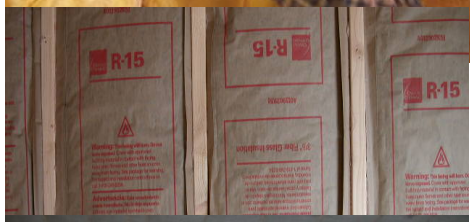


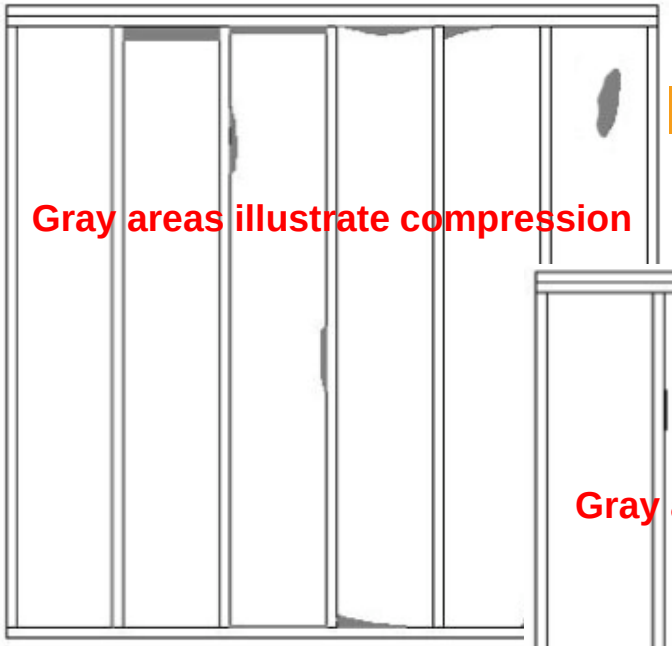
* An Air Barrier is any solid material that blocks air flow including sealing at edges and seams

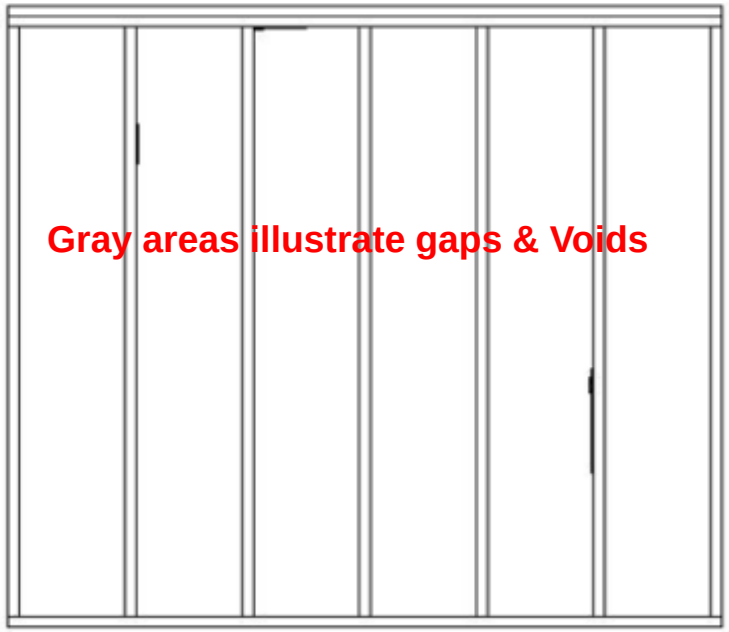
RESNET Standards – Grade I Insulation

- Installed according to manufacturer's instructions
- Fills each cavity side-to-side and top-to-bottom
- No substantial gaps, voids, compressions, or obstructions
- Split or fitted tightly around wiring or obstructions in wall
- Occasional very small gaps are acceptable for "Grade I"
- Compression or incomplete fill amounting to 2% or less, if the empty spaces are less than 30% of the intended fill thickness, are acceptable for "Grade I".

RESNET Standards – Grade I Insulation







Wall insulation:

- **Must be enclosed on all six sides**
- **Must be in substantial contact with the sheathing material.**
- **No sheathing visible through gaps in material**

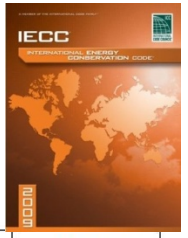


TABLE 402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	1.2	0.75	0.30	30	13	3/4	13	0	0	0
2	0.65[j]	0.75	0.30	30	13	4/6	13	0	0	0
3	0.50[j]	0.65	0.30	30	13	5/8	19	5/13[f]	0	5/13
4 except Marine	0.35	0.60	NR	38	13	5/10	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	20 or 13+5[h]	13/17	30[g]	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	20 or 13+5[h]	15/19	30[g]	15/19	10, 4 ft	10/13
7 and 8	0.35	0.60	NR	49	21	19/21	38[g]	15/19	10, 4 ft	10/13

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. R-19 batts compressed into a nominal 2 × 6 framing cavity such that the *R*-value is reduced by R-1 or more shall be marked with the compressed batt *R*-value in addition to the full thickness *R*-value.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.

c. "15/19" means R-15 continuous insulated sheathing on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulated sheathing on the interior or exterior of the home. "10/13" means R-10 continuous insulated sheathing on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

d. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Zones 1 through 3 for heated slabs.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure 301.1 and Table 301.1.

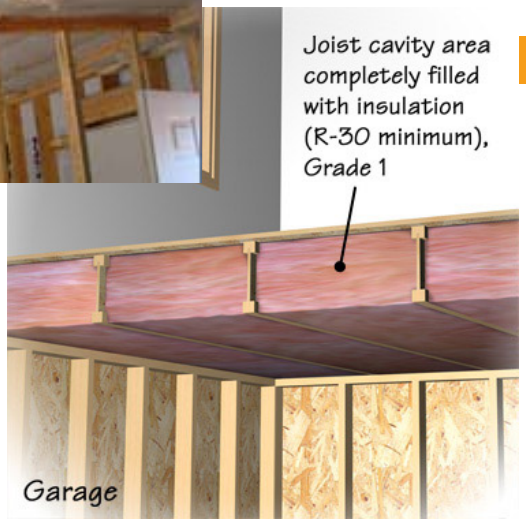
g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

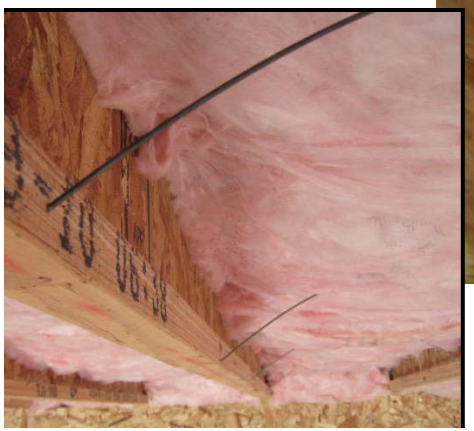
h. "13+5" means R-13 cavity insulation plus R-5 insulated sheathing. If structural sheathing covers 25 percent or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25 percent of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-2.

i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

j. For impact rated fenestration complying with Section R301.2.1.2 of the *International Residential Code* or Section 1608.1.2 of the *International Building Code*, the maximum *U*-factor shall be 0.75 in Zone 2 and 0.65 in Zone 3.

Floor Systems





- Best Practices
  - Insulation must be in contact with the surface it is intended to insulate
  - Insulation completely fills the cavity

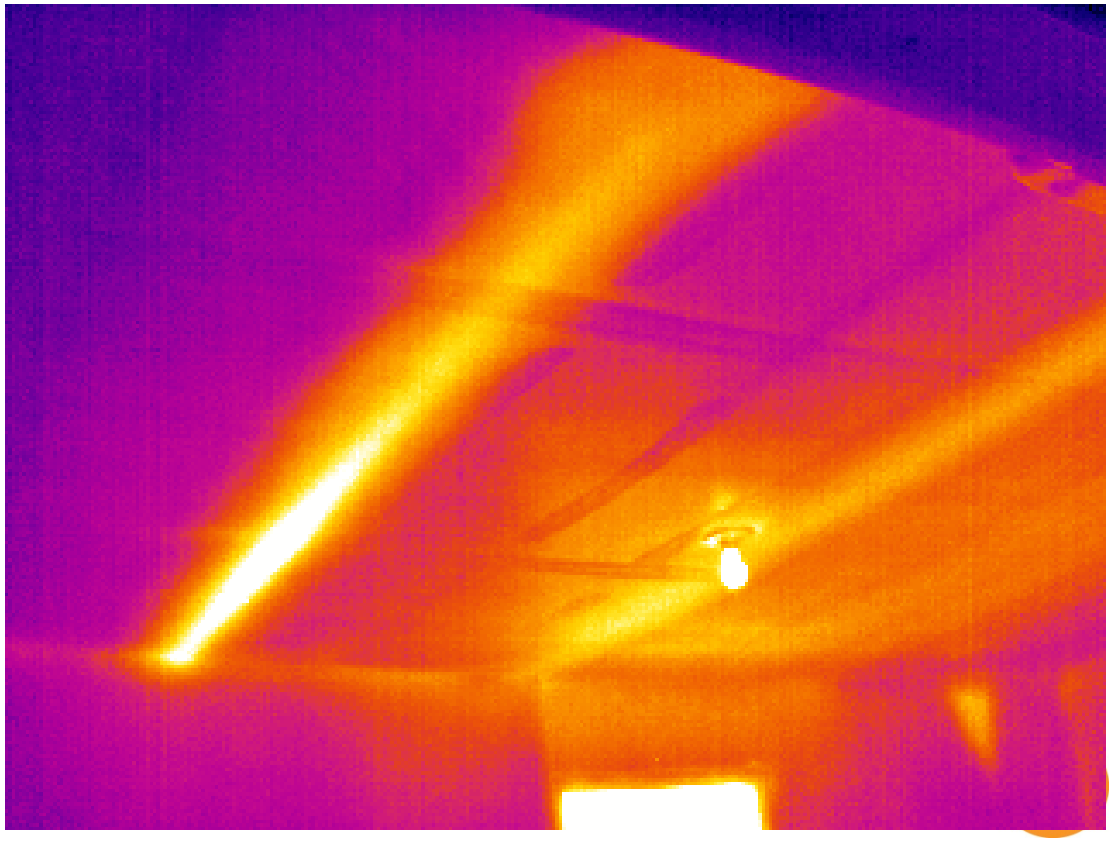
2009 IECC

- Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.
- **R-30 climate zone 5**

Ducts in Garage Ceiling

Old Installation methods

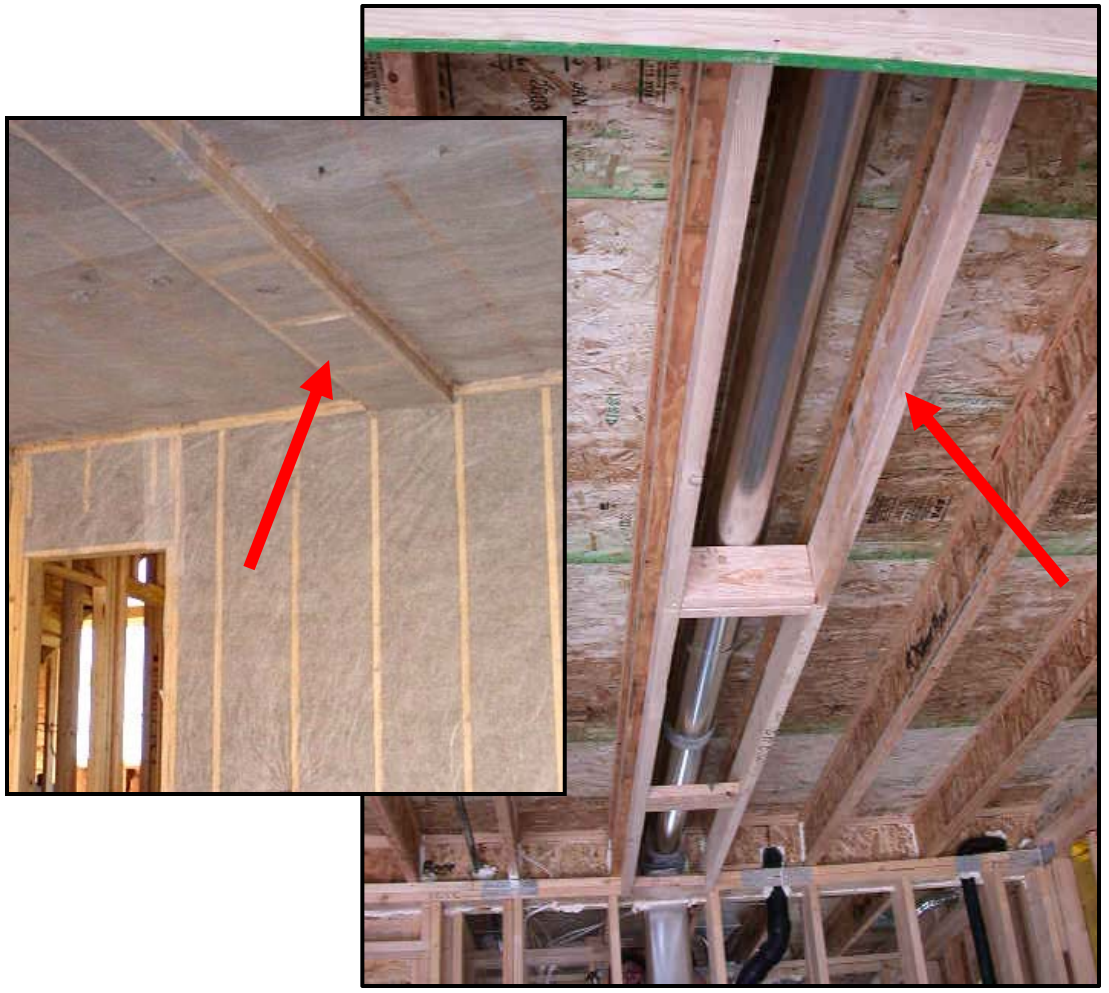
What about obstructions in the floor system



Ducts in Garage Ceiling

Code requirements

- Insulation in complete contact with subfloor
- Insulation encapsulates duct
- Footnote G
- **Minimum R-19 below duct**



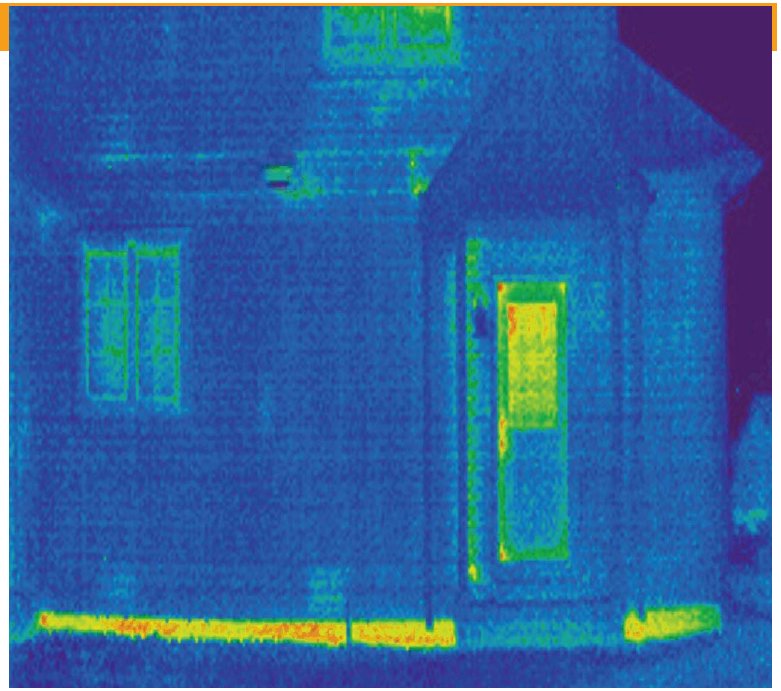
100% Slab Edge Insulation 4.2

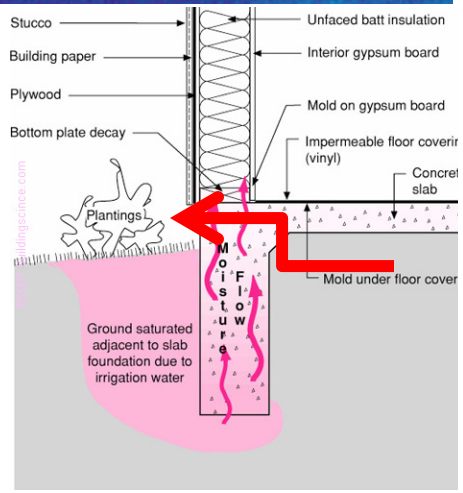
Exception:

- A post-tensioned slab with an integrated porch foundation, and,
- Multi-family buildings with integrated garage foundations

Not Except:

- Walkout basements





Thermal Enclosure Systems Rater Checklist – 4. Thermal Bridging

- 4.4 Reduced thermal bridging at walls with one of the following options:
  - Continuous rigid insulated sheathing **OR**
  - SIPS **OR**
  - ICF **OR**
  - Double wall framing **OR**
  - Advanced framing including
    - All corners insulated 2 or3 stud **&**
    - All headers above windows & doors insulated **&**
    - Framing limited at all windows and doors **&**
    - All interior / exterior wall intersections insulated **&**
    - Stud spacing (NEW)

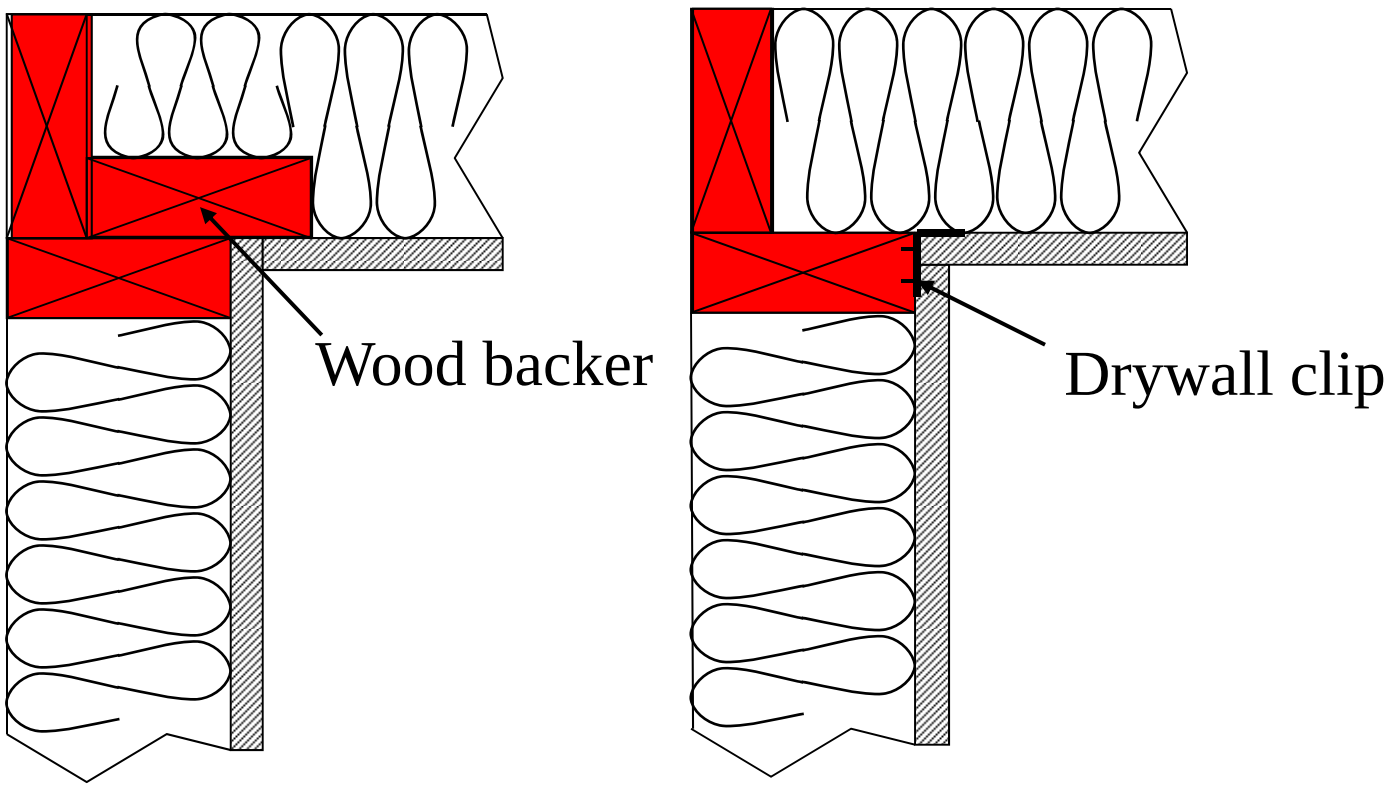
Stud Spacing: Footnote #21

- Minimum stud spacing of 16 in. o.c. for 2x4 framing in all Climate Zones and, in Climate Zones 5 through 8, 24 in. o.c. for 2x6 framing
  - So in CZ 5-8 you have a choice if the house meets the 2009 IECC
- In Climate Zones 5 - 8, a minimum stud spacing of 16 in. o.c. **is permitted to be used with 2x6 framing** **if** ≥ R-20.0 wall cavity insulation is achieved
- Regardless, all vertical framing members shall either be on-center or have an alternative structural purpose that is apparent
- **Or** documented in a framing plan that encompasses that member and is provided by the builder, architect, designer, or engineer
  - Document why you need more wood
- However, all 2x6 framing with stud spacing of 16 in. o.c. in Climate Zones 5 - 8 **shall have ≥ R-20.0 wall cavity insulation installed** regardless of any framing plan or alternative equivalent total UA calculation.

Thermal Bridging

Three and Two Stud Corners

- Framing Details, IRC Figure R602.3(2)
- Backing studs omitted by using wood backer or drywall clips



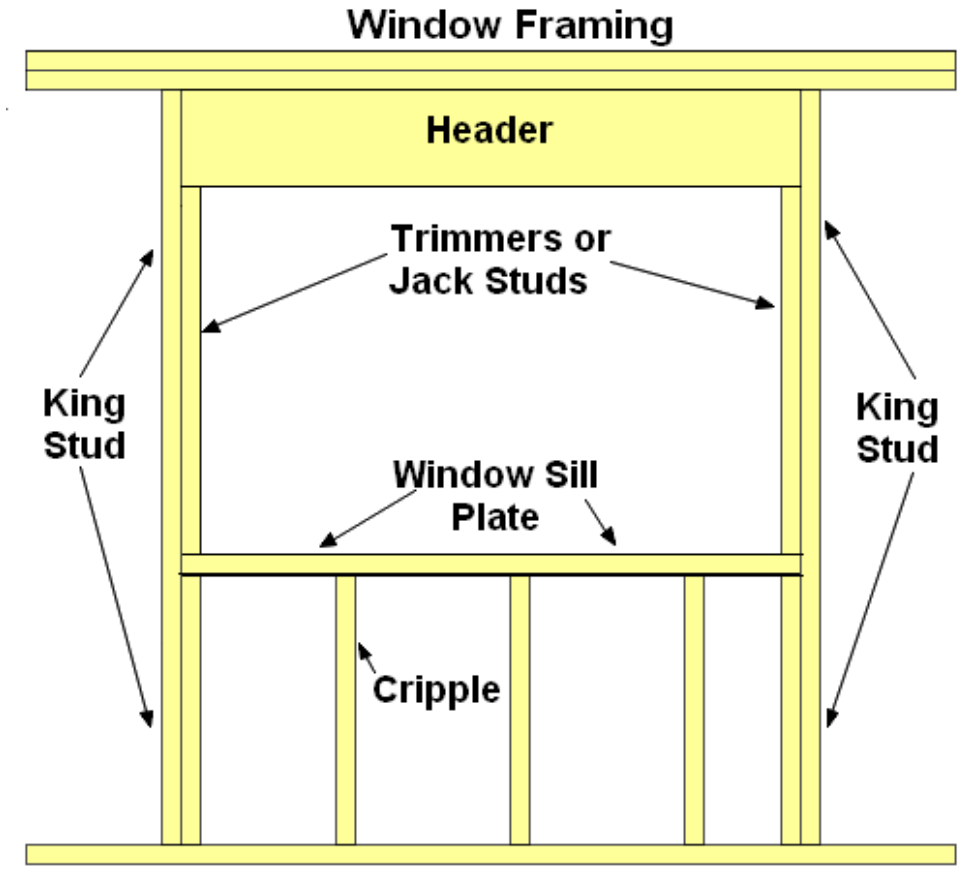
Insulated Headers: R-5

Interior wall meets exterior wall

Ladder Blocking

Continuous 2x6 behind 2x4

Framing limited at all windows and doors

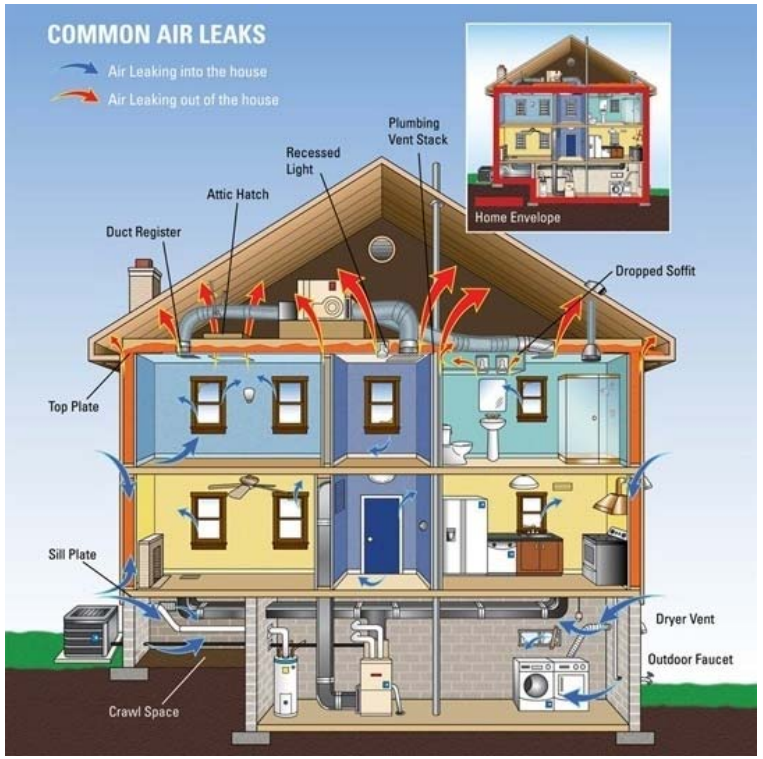


- Framing at windows shall be limited to a maximum
  - One pair of king studs per window opening
  - One pair jack studs per window opening to support the header and window sill
    - Additional jack studs shall be used only as needed for structural support
  - Cripple studs only as needed to maintain on-center spacing of studs

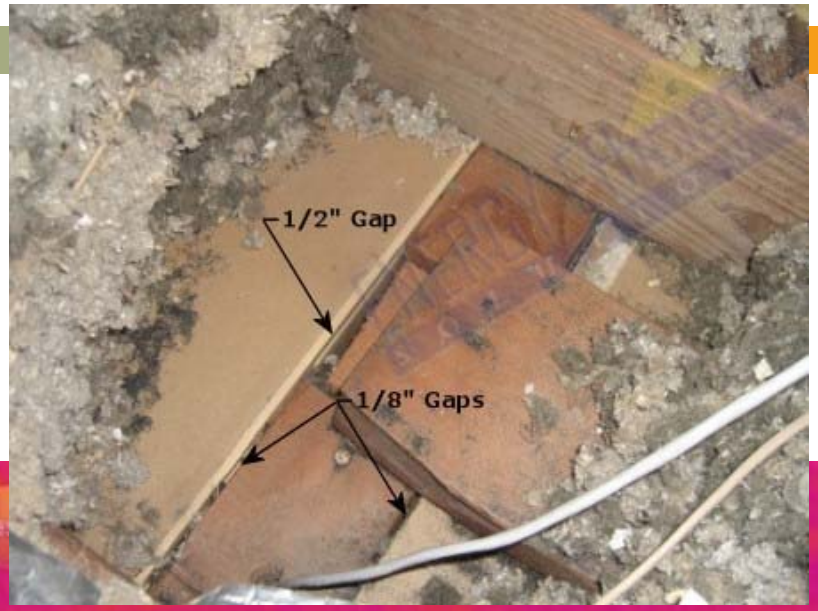
Thermal Enclosure Systems Rater Checklist

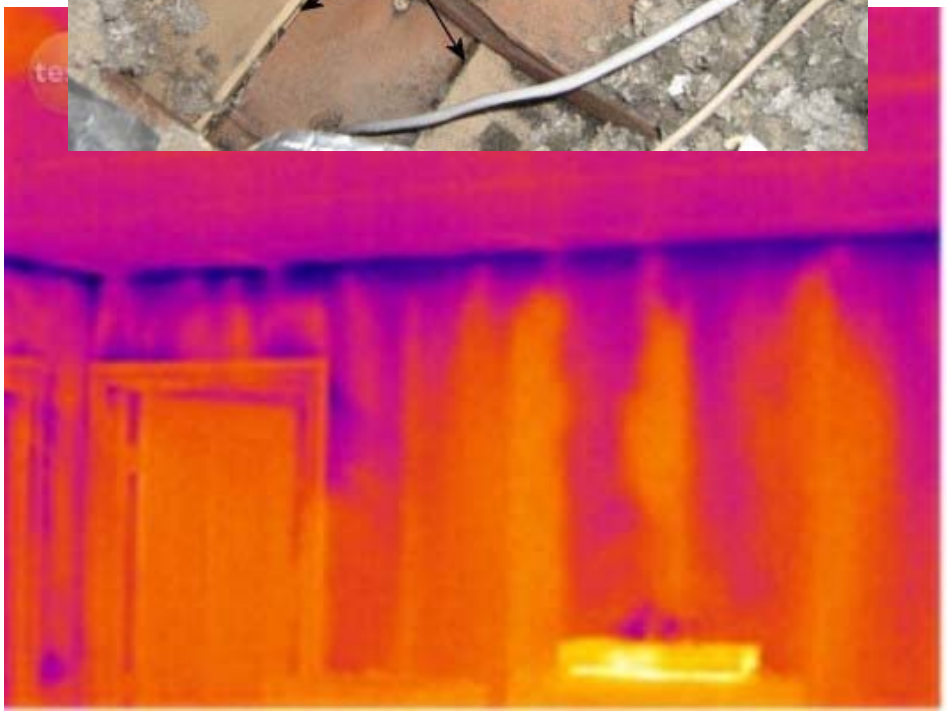
Air sealing

- Penetrations to unconditioned space fully sealed with solid blocking or flashing as needed and gaps sealed with caulk or foam
-
- What's New

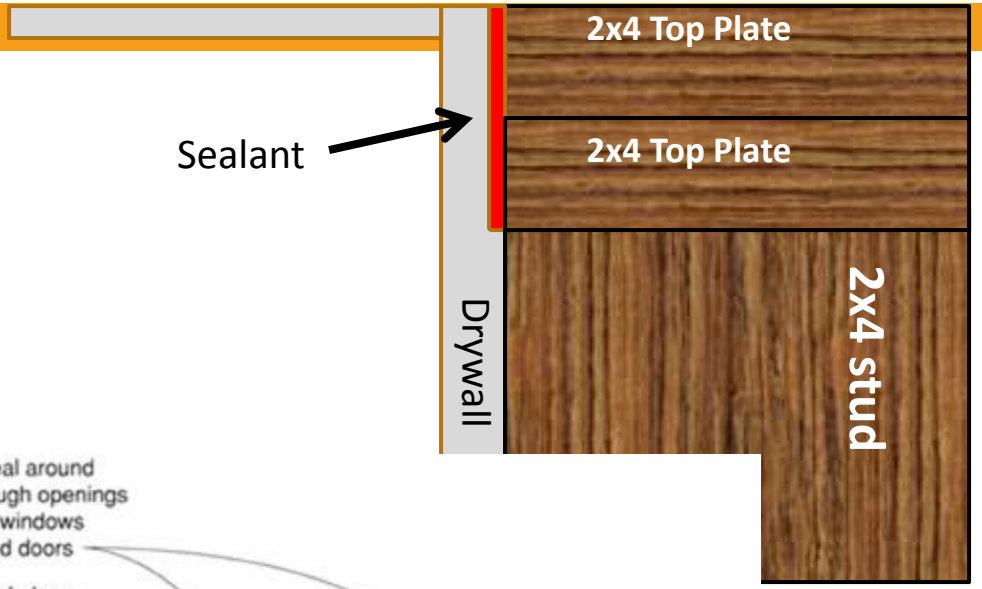


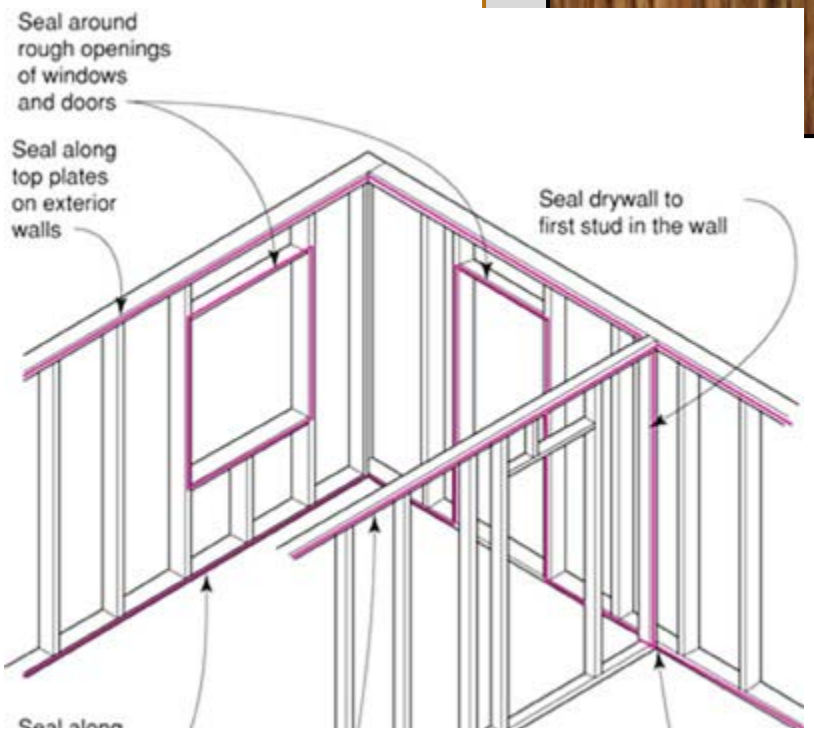
5.2.3 Sheetrock sealed to top plate at all attic/wall interfaces using silicone caulk, latex foam, or equivalent material.



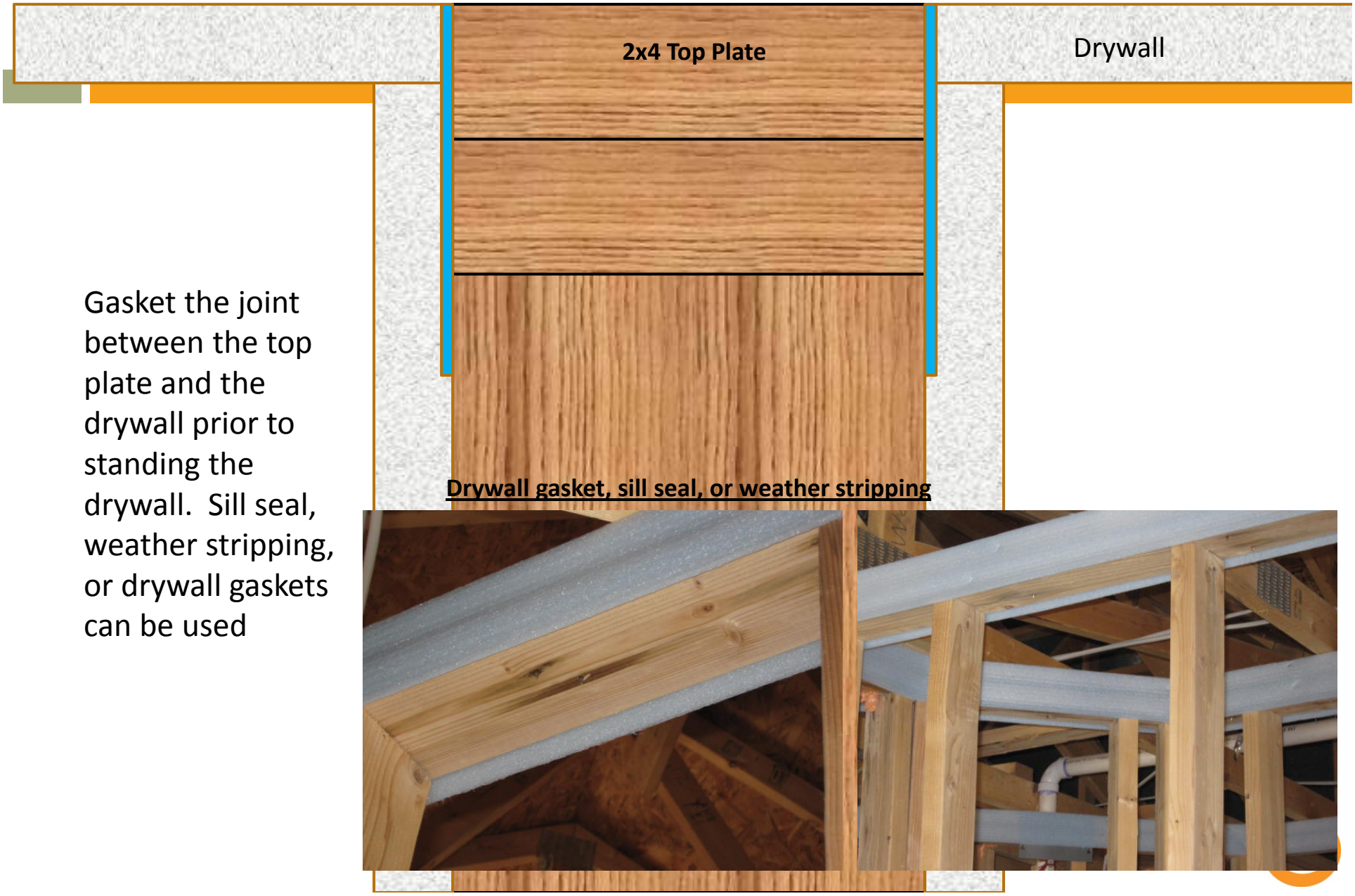


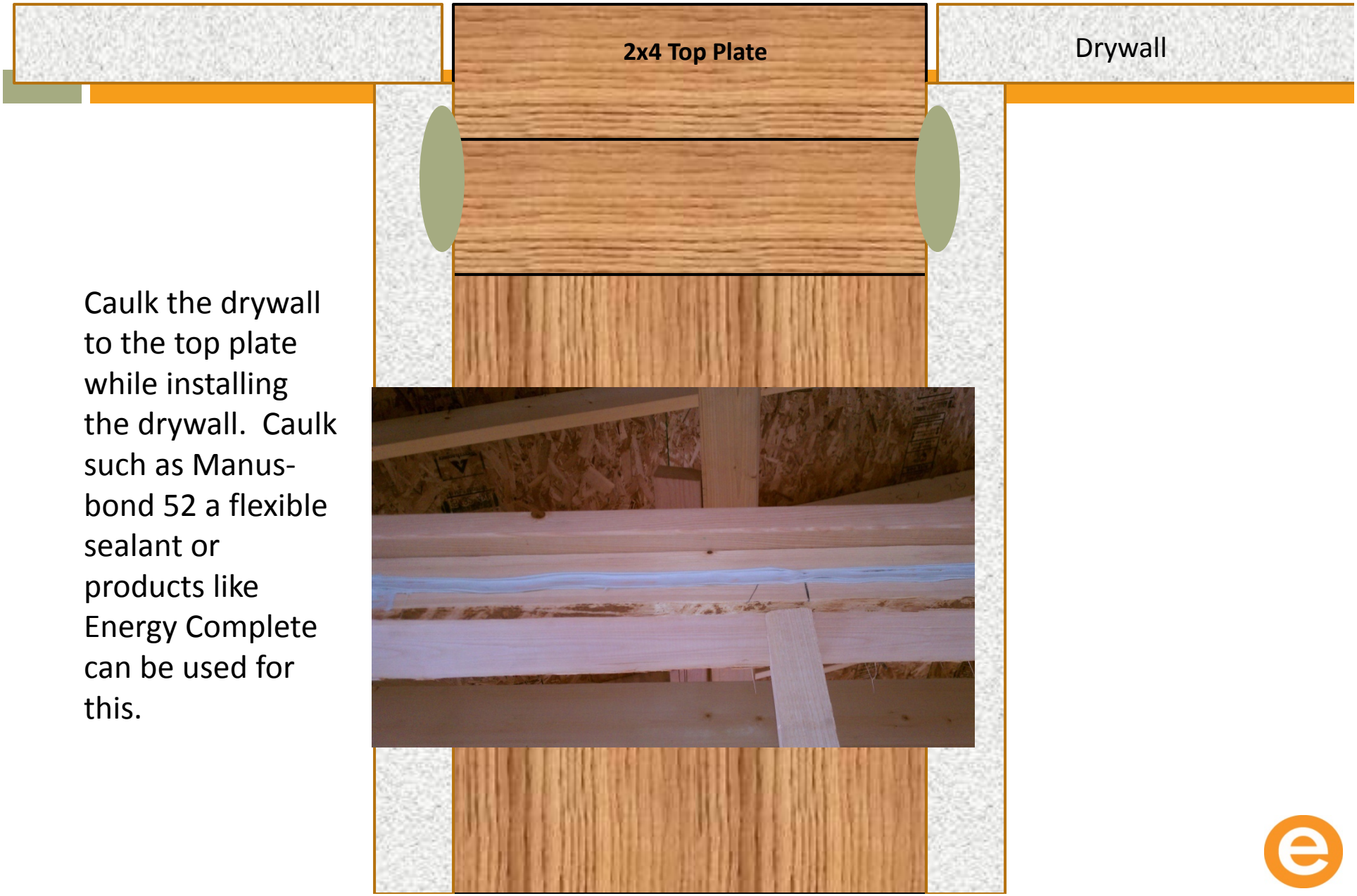
5.2.3 Sheetrock sealed to top plate at all attic/wall interfaces using silicone caulk, latex foam, or equivalent material. Construction adhesive shall not be used





Gasket the joint between the top plate and the drywall prior to standing the drywall. Sill seal, weather stripping, or drywall gaskets can be used



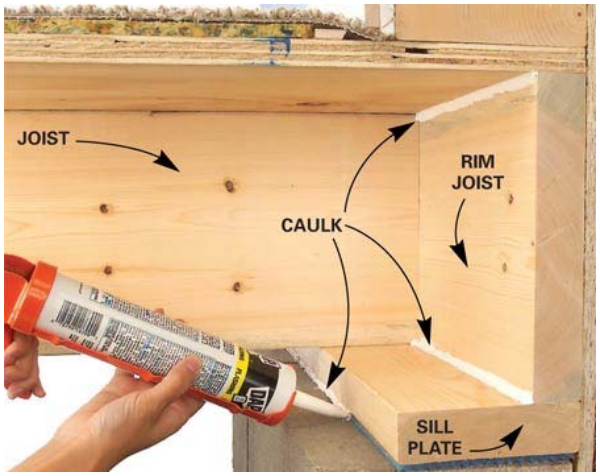


Caulk the drywall to the top plate while installing the drywall. Caulk such as Manus-bond 52 a flexible sealant or products like Energy Complete can be used for this.

Junction of foundation and sill plate is sealed

- Belts and suspenders required

Junction of foundation and sill plate is sealed



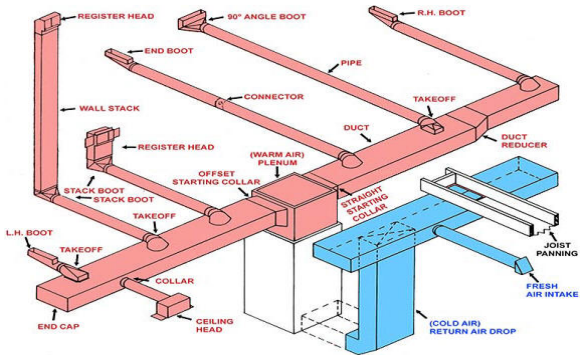
HVAC Systems Quality Installation Contractor Checklist

- The Checklist is designed to align with the requirements of ASHRAE 62.2-2007 and ANSI / ACCA's 5 **QI**-2007 protocol
- Improving the performance of HVAC equipment in new homes when compared to homes built to minimum code

LENNOX
Rheem
Carrier
Turn to the Experts
bryant
Heating & Cooling Systems
American Standard
HEATING & AIR CONDITIONING
Amana
Goodman
Air Conditioning & Heating
TRANE
It's Hard To Stop A Trane.
Westinghouse
YORK
It's time to get comfortable.
RUUD

2. Heating & Cooling System Design
HVAC Design Guidelines

- **Minimize it** - Bigger is not better
  - System sizing should be just right / Get the proper Load
- **Simplify it** - More is not better
  - Simple duct systems have benefits
- **Design it** - 1st step to ensured comfort & efficiency
  - Proper system sizing and equipment matching
  - Get the proper flow and ensure the load is distributed correctly
- **Seal it** - Tight ducts perform better
  - Building durability / Safety / Energy Efficiency / Comfort
- **Insulate it** – Even better
  - Ensure the system is inside the envelope
- **Verify it** – You get what you inspect
  - Commissioning is were it's at – Charge and flow



Energy Star HVAC Requirements

- HVAC contractors or Designers are required to be **'Credentialed'** by an EPA–recognized third–party training and oversight organization (H-QUITO)
- HVAC contractors/Designers seeking to be credentialed by an H-QUITO must:
  - Attend an HVAC QI/ENERGY STAR orientation training class offered by the H-QUITO
  - Submit an application
  - Demonstrates that they possess the knowledge, skills, and abilities to effectively deliver the HVAC Quality Installation services required in the ENERGY STAR HVAC QI checklist
  - Be subject to **Quality Assurance** oversight by the H-QUITO

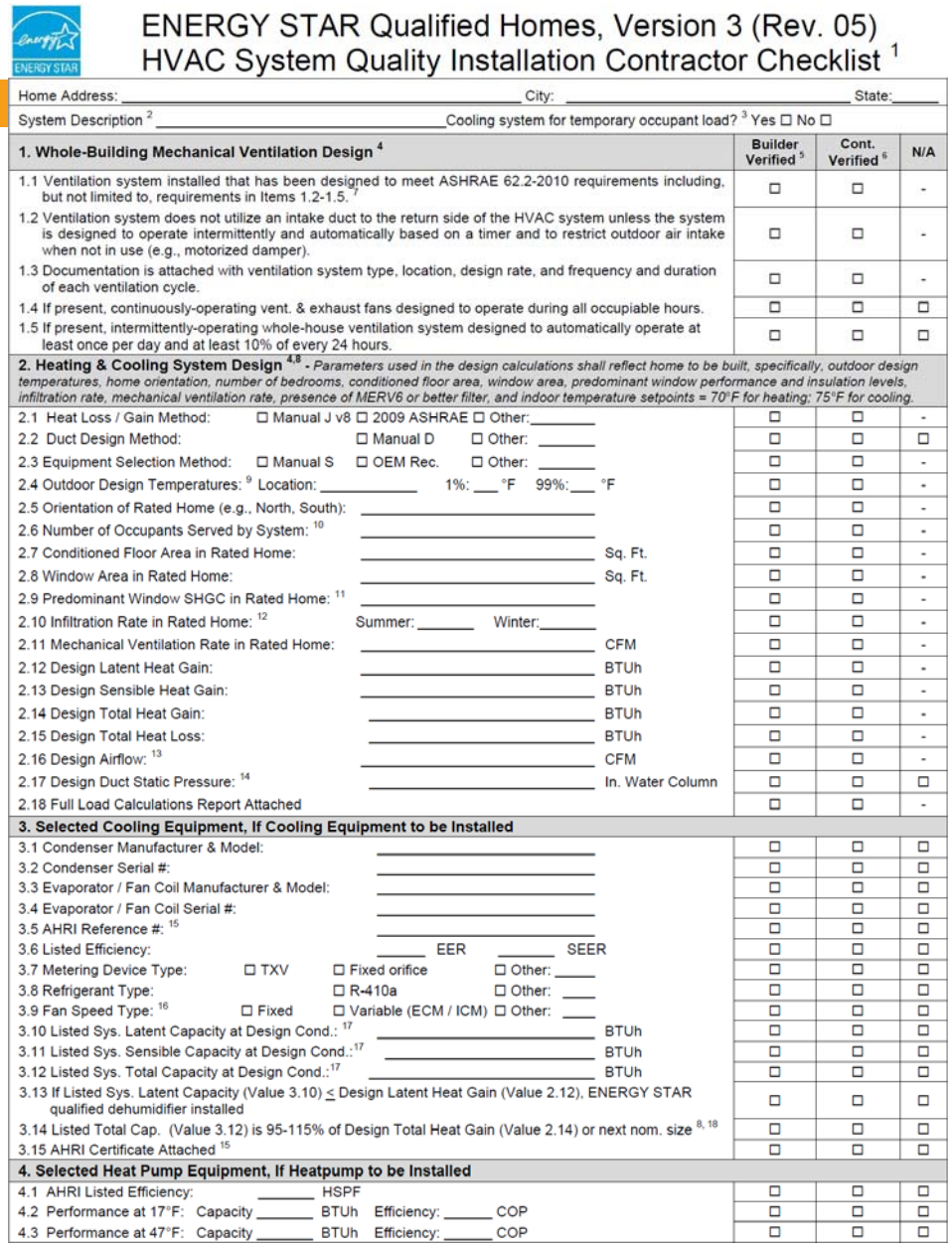
H-QUITO

- Currently ACCA is the only EPA–recognized third–party training and oversight organization

ACCA QUALITY ASSURED
HVAC

HVAC System Quality Installation Contractor Checklist

- Page one is all about proper system design
  - Manual J
  - Manual S
  - Manual D
- Ventilation Design
  - ASHRAE 62.2
- Heating and Cooling Equipment Selection
- AHRI or OEM Properly matched systems



ENERGY STAR Qualified Homes, Version 3 (Rev. 05)
HVAC System Quality Installation Contractor Checklist [1]

Home Address: _____ City: _____ State:_____

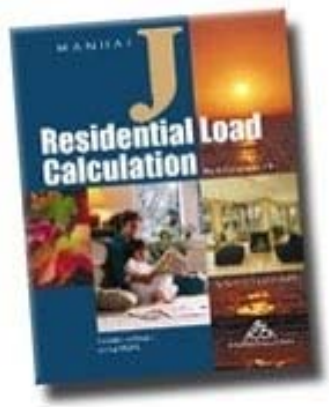
System Description [2] _____ Cooling system for temporary occupant load? [3] Yes ☐ No ☐

1. Whole-Building Mechanical Ventilation Design [4]	Builder Verified [5]	Cont. Verified [6]	N/A
1.1 Ventilation system installed that has been designed to meet ASHRAE 62.2-2010 requirements including, but not limited to, requirements in Items 1.2-1.5. [7]	☐	☐	-
1.2 Ventilation system does not utilize an intake duct to the return side of the HVAC system unless the system is designed to operate intermittently and automatically based on a timer and to restrict outdoor air intake when not in use (e.g., motorized damper).	☐	☐	-
1.3 Documentation is attached with ventilation system type, location, design rate, and frequency and duration of each ventilation cycle.	☐	☐	-
1.4 If present, continuously-operating vent. & exhaust fans designed to operate during all occupiable hours.	☐	☐	☐
1.5 If present, intermittently-operating whole-house ventilation system designed to automatically operate at least once per day and at least 10% of every 24 hours.	☐	☐	☐
2. Heating & Cooling System Design [4,8] - *Parameters used in the design calculations shall reflect home to be built, specifically, outdoor design temperatures, home orientation, number of bedrooms, conditioned floor area, window area, predominant window performance and insulation levels, infiltration rate, mechanical ventilation rate, presence of MERV6 or better filter, and indoor temperature setpoints = 70°F for heating; 75°F for cooling.*			
2.1 Heat Loss / Gain Method: ☐ Manual J v8 ☐ 2009 ASHRAE ☐ Other:_____	☐	☐	-
2.2 Duct Design Method: ☐ Manual D ☐ Other: _____	☐	☐	☐
2.3 Equipment Selection Method: ☐ Manual S ☐ OEM Rec. ☐ Other: _____	☐	☐	-
2.4 Outdoor Design Temperatures: [9] Location: _____ 1%: ___ °F 99%: ___ °F	☐	☐	-
2.5 Orientation of Rated Home (e.g., North, South): _____	☐	☐	-
2.6 Number of Occupants Served by System: [10] _____	☐	☐	-
2.7 Conditioned Floor Area in Rated Home: _____ Sq. Ft.	☐	☐	-
2.8 Window Area in Rated Home: _____ Sq. Ft.	☐	☐	-
2.9 Predominant Window SHGC in Rated Home: [11] _____	☐	☐	-
2.10 Infiltration Rate in Rated Home: [12] Summer: _____ Winter:_____	☐	☐	-
2.11 Mechanical Ventilation Rate in Rated Home: _____ CFM	☐	☐	-
2.12 Design Latent Heat Gain: _____ BTUh	☐	☐	-
2.13 Design Sensible Heat Gain: _____ BTUh	☐	☐	-
2.14 Design Total Heat Gain: _____ BTUh	☐	☐	-
2.15 Design Total Heat Loss: _____ BTUh	☐	☐	-
2.16 Design Airflow: [13] _____ CFM	☐	☐	-
2.17 Design Duct Static Pressure: [14] _____ In. Water Column	☐	☐	☐
2.18 Full Load Calculations Report Attached	☐	☐	-
3. Selected Cooling Equipment, If Cooling Equipment to be Installed			
3.1 Condenser Manufacturer & Model: _____	☐	☐	☐
3.2 Condenser Serial #: _____	☐	☐	☐
3.3 Evaporator / Fan Coil Manufacturer & Model: _____	☐	☐	☐
3.4 Evaporator / Fan Coil Serial #: _____	☐	☐	☐
3.5 AHRI Reference #: [15] _____	☐	☐	☐
3.6 Listed Efficiency: _____ EER _____ SEER	☐	☐	☐
3.7 Metering Device Type: ☐ TXV ☐ Fixed orifice ☐ Other: ____	☐	☐	☐
3.8 Refrigerant Type: ☐ R-410a ☐ Other: ____	☐	☐	☐
3.9 Fan Speed Type: [16] ☐ Fixed ☐ Variable (ECM / ICM) ☐ Other: ____	☐	☐	☐
3.10 Listed Sys. Latent Capacity at Design Cond.: [17] _____ BTUh	☐	☐	☐
3.11 Listed Sys. Sensible Capacity at Design Cond.: [17] _____ BTUh	☐	☐	☐
3.12 Listed Sys. Total Capacity at Design Cond.: [17] _____ BTUh	☐	☐	☐
3.13 If Listed Sys. Latent Capacity (Value 3.10) ≤ Design Latent Heat Gain (Value 2.12), ENERGY STAR qualified dehumidifier installed	☐	☐	☐
3.14 Listed Total Cap. (Value 3.12) is 95-115% of Design Total Heat Gain (Value 2.14) or next nom. size [8, 18]	☐	☐	☐
3.15 AHRI Certificate Attached [15]	☐	☐	☐
4. Selected Heat Pump Equipment, If Heatpump to be Installed			
4.1 AHRI Listed Efficiency: _____ HSPF	☐	☐	☐
4.2 Performance at 17°F: Capacity _____ BTUh Efficiency: _____ COP	☐	☐	☐
4.3 Performance at 47°F: Capacity _____ BTUh Efficiency: _____ COP	☐	☐	☐

ESv3 Design for House Plans with Multiple Configurations
(orientations, elevations, options)

- For Homes Completed in 2013
  - The load shall be competed for each configuration
  - If the loads across configurations vary by ≤ 25% then the largest load can be used subject to oversize rules established by Manual S
- Designed air flow
  - Room level designed air flows shall be done for each configuration unless air flows across configurations vary by ≤ 25% or 25 CFM then the average shall be permitted
- Basically looking for site specific design to determine loads and flows

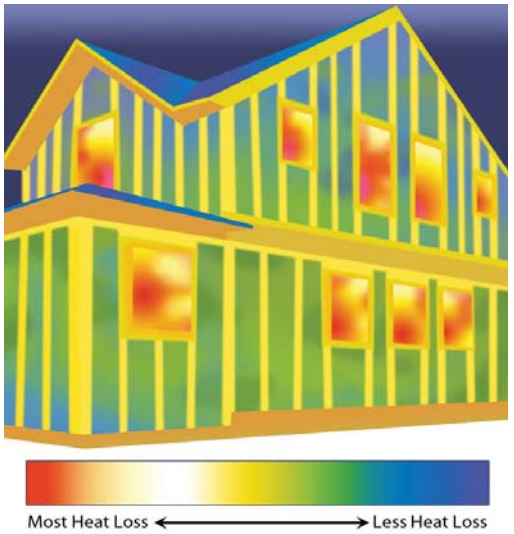
How Manual J Works



- Manual J describes every component of the thermal envelope
- Determines the Btu per hour of heat loss and heat gain through the envelope at specific design temperatures
- End result – the heating and cooling load for the house
- Room by Room load

How Manual J Works

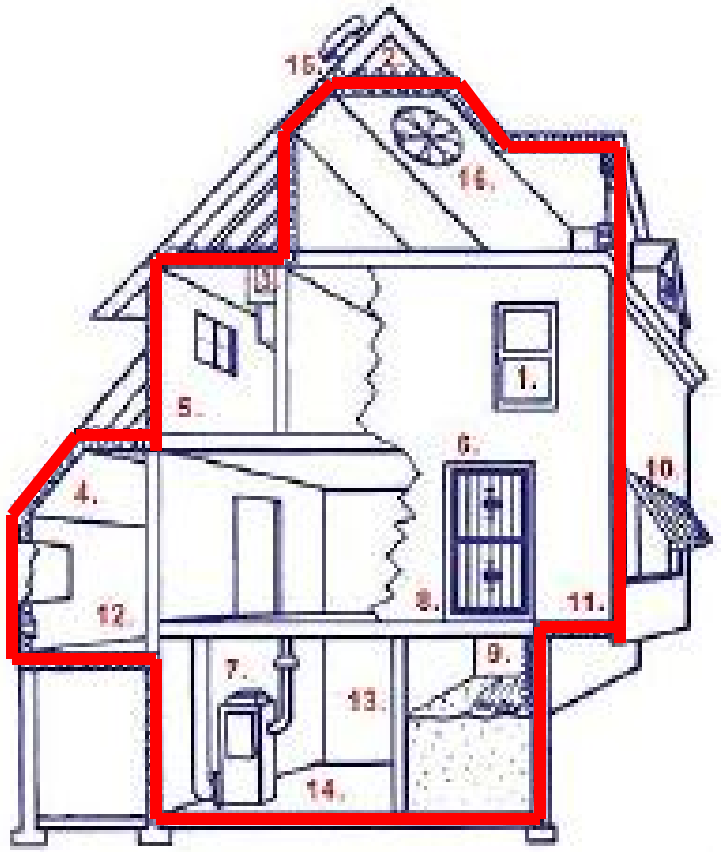
- BTU per hour of heat loss or heat gain through an assembly U x A x ΔT = Q(Btuh)
  - U-value x Sqft x Delta T = Btu per hours
- Example
  - 500 sqft
  - R-19
  - Indoor temp at 70° and
  - Outdoor temp at 3°
- .053 x 500 x 67 = 17,755 Btu per hours



Thermal Enclosure Systems Rater Checklist

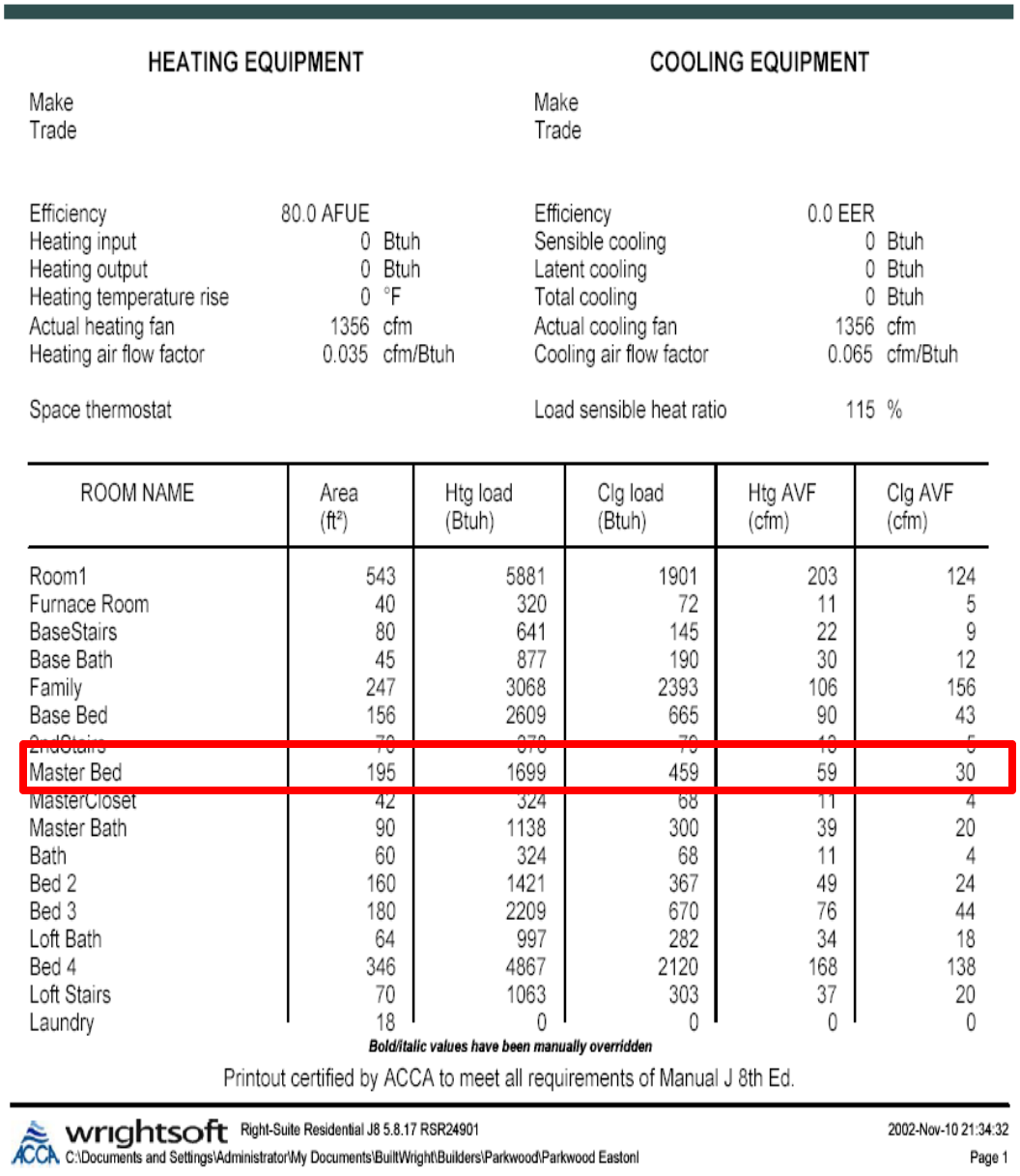
Ensuring the HVAC Contractor they are getting the Thermal envelope they are designing to

- Use the actual R-values, U-values and SHHC
- RESNET Grade 1 insulation
- Defined Thermal Boundary
  - Air barrier and thermal barrier alignment
- Air sealing
  - Tight Envelopes



Manual D

- Determine how much flow is needed to achieve comfort in each room based on distributing the load to each room in the house



HEATING EQUIPMENT

Make
Trade

Efficiency	80.0 AFUE	
Heating input	0	Btuh
Heating output	0	Btuh
Heating temperature rise	0	°F
Actual heating fan	1356	cfm
Heating air flow factor	0.035	cfm/Btuh
Space thermostat		

COOLING EQUIPMENT

Make
Trade

Efficiency	0.0 EER	
Sensible cooling	0	Btuh
Latent cooling	0	Btuh
Total cooling	0	Btuh
Actual cooling fan	1356	cfm
Cooling air flow factor	0.065	cfm/Btuh
Load sensible heat ratio	115	%

ROOM NAME	Area (ft^2)	Htg load (Btuh)	Clg load (Btuh)	Htg AVF (cfm)	Clg AVF (cfm)
Room1	543	5881	1901	203	124
Furnace Room	40	320	72	11	5
BaseStairs	80	641	145	22	9
Base Bath	45	877	190	30	12
Family	247	3068	2393	106	156
Base Bed	156	2609	665	90	43
2ndStairs	70	878	79	10	5
Master Bed	195	1699	459	59	30
MasterCloset	42	324	68	11	4
Master Bath	90	1138	300	39	20
Bath	60	324	68	11	4
Bed 2	160	1421	367	49	24
Bed 3	180	2209	670	76	44
Loft Bath	64	997	282	34	18
Bed 4	346	4867	2120	168	138
Loft Stairs	70	1063	303	37	20
Laundry	18	0	0	0	0

Bold/italic values have been manually overridden

Printout certified by ACCA to meet all requirements of Manual J 8th Ed.

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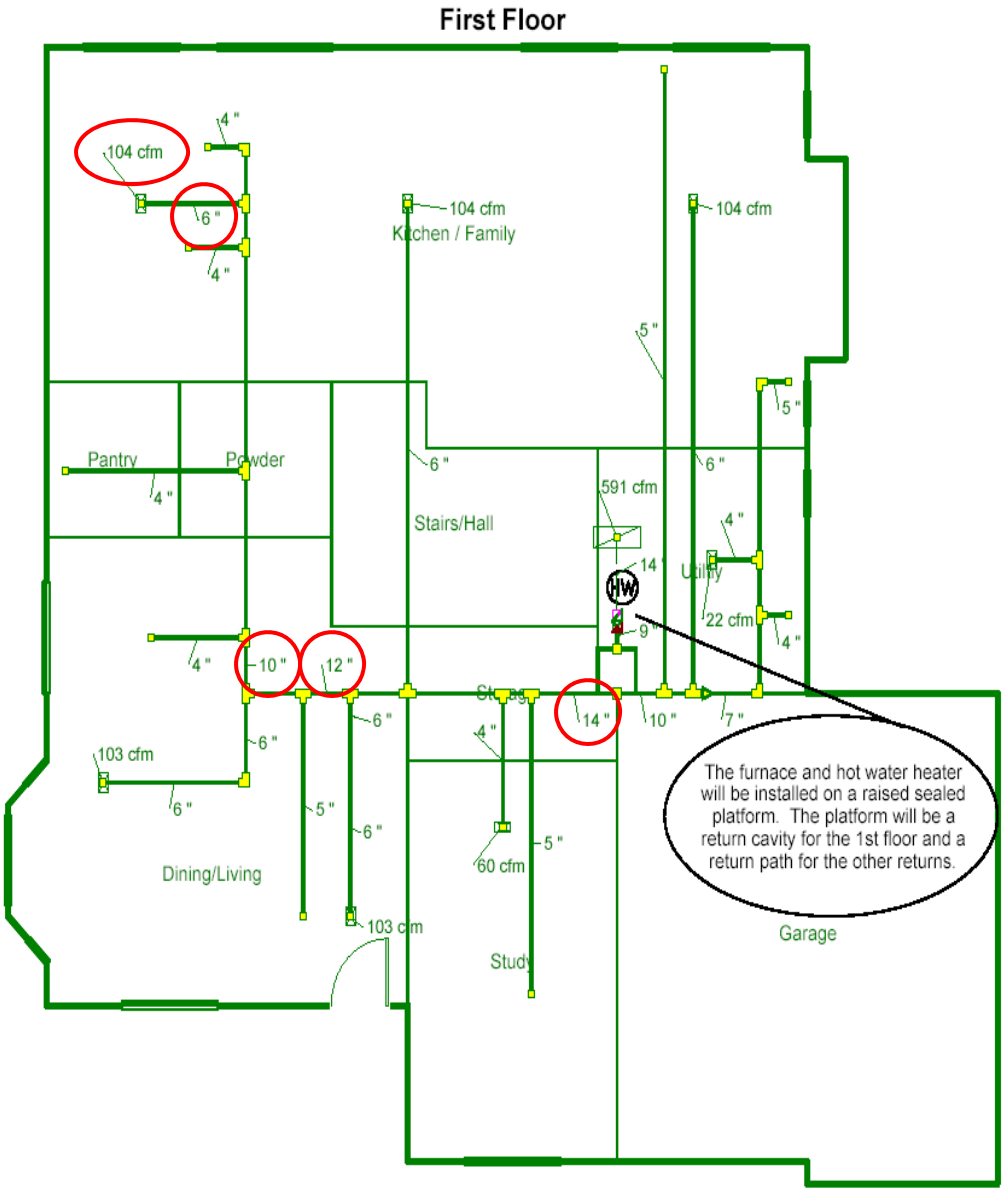
Duct Design

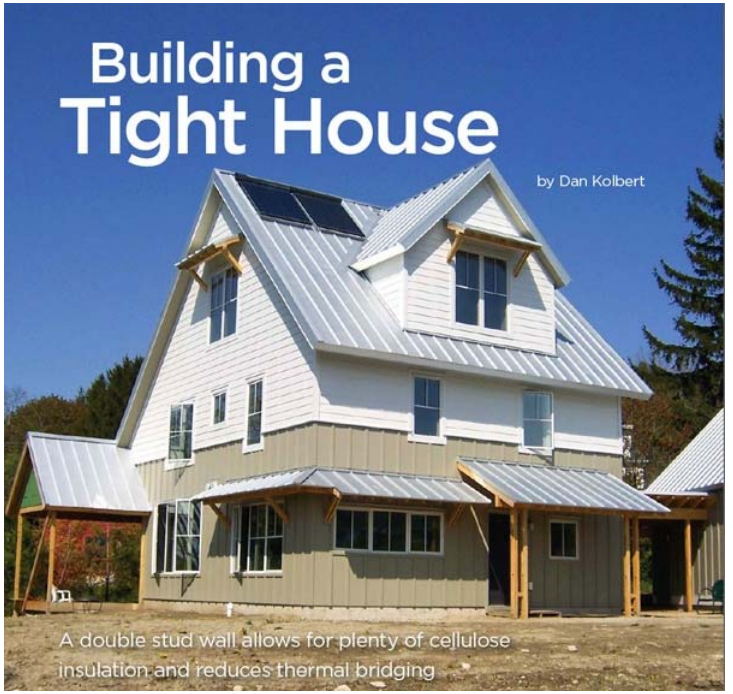
- Determine how to design, size, and run the duct system to ensure the proper flow and distribution of the Btu's



Can a House Be Too Tight?

NO!

- Wrong question
- Control **air flow**
- In order to control the air



Real question .....

- Can houses be under-ventilated?

YES!

Build Tight and Ventilate Right

Whole-Building Mechanical Ventilation Design

ASHRAE Standard 62.2 - 2010

- Standard for establishing consistent ventilation in a house
- Both Whole House **Controlled Mechanical Ventilation** and **Spot ventilation** standard
- This standard applies to spaces intended for human occupancy within **single-family houses and multifamily structures of three stories or fewer** above grade, including manufactured and modular houses

Local Exhaust or "Spot Ventilation" *Ventilation* Removes pollutants, Moisture, and odors at their source

- **Baths:**
  - **50 CFM intermittent**
  - **20 CFM continuous**
- **Kitchens:**
  - **100 CFM intermittent**
  - **25 CFM continuous**
  - **Ducted to outside**

Whole House Controlled Mechanical

- Whole Building Ventilation supplies fresh air to a structure through one of the following methods:
  - Exhaust Ventilation (Bath fan such as a Panasonic Whisper green)
  - Supply Ventilation (uses the furnace fan blower)
  - Balanced Ventilation (Heat Recovery Ventilator)

- There must be a control
- Formula:

Fan flow (CFM) = 0.01 CFM x your floor area + 7.5 x (your number of bedrooms + 1)

- For a 2200 square foot 4-bedroom home,

(0.01 X 2200) + (7.5 times 5)

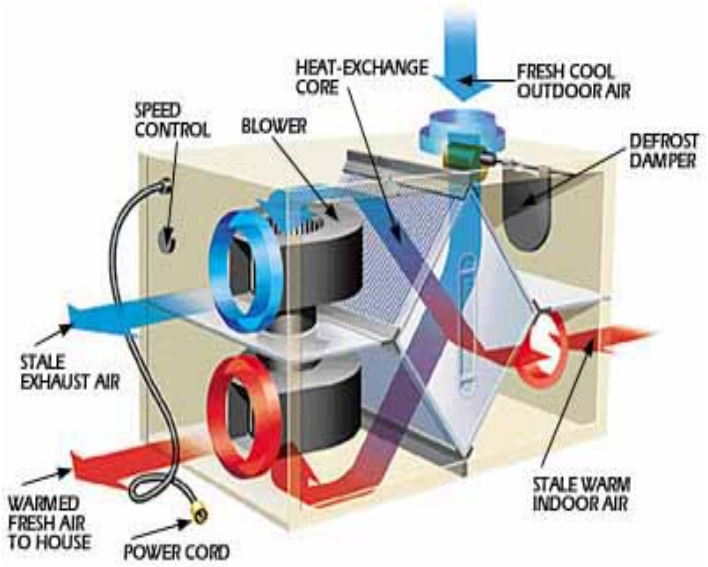
60 CFM

Pick Your Ventilation Strategy Carefully to Maximize Performance

Built Tight Ventilate Right

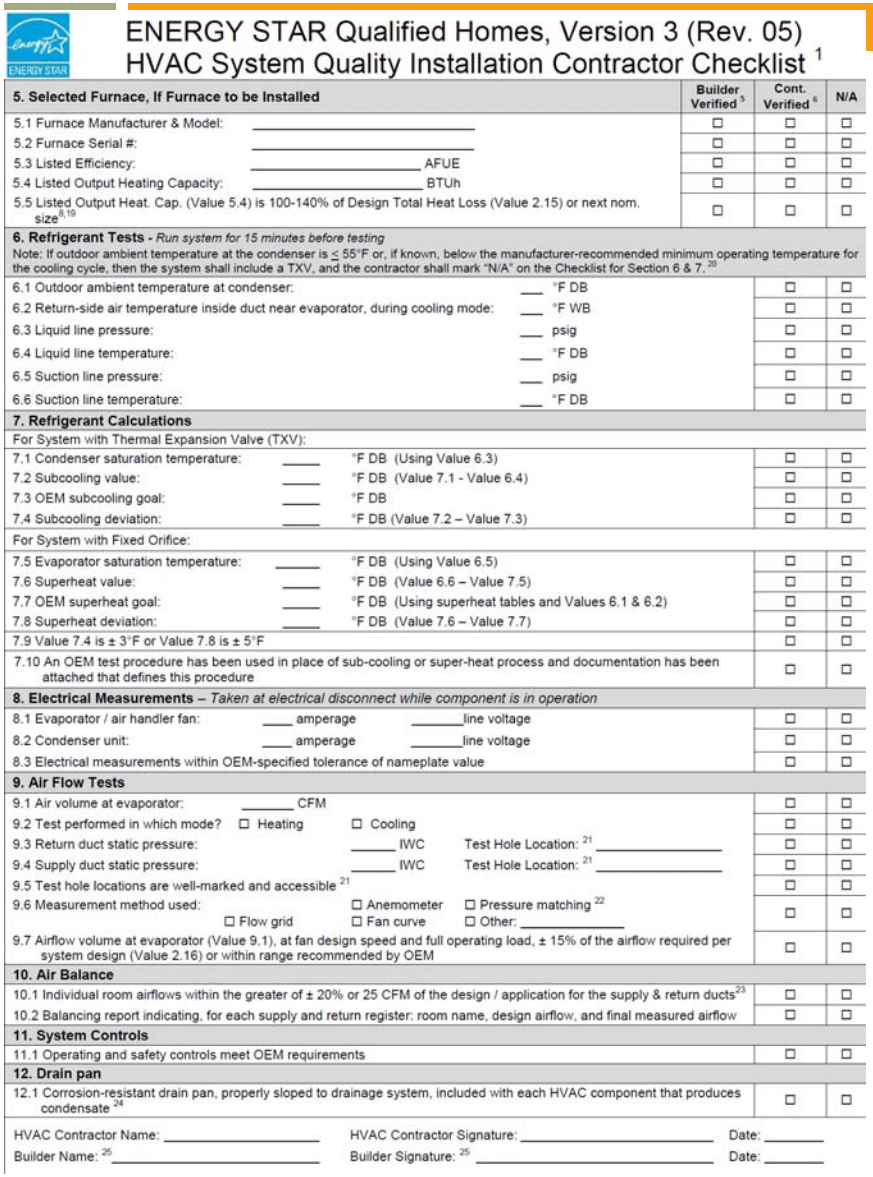
Three Strategies

- Supply Ventilation
  (Furnace blower must be ECM/ICM)
- Exhaust Ventilation
  - Possible configuration with reversed dampered designed opening to outside
- Balanced Ventilation



HVAC System Quality Installation Contractor Checklist:

- Page two is all about commissioning



ENERGY STAR Qualified Homes, Version 3 (Rev. 05)
HVAC System Quality Installation Contractor Checklist [1]

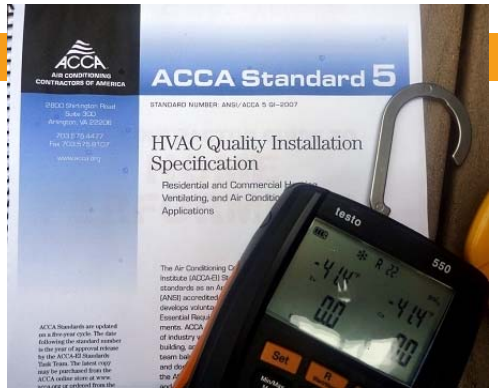
5. Selected Furnace, If Furnace to be Installed	Builder Verified [5]	Cont. Verified [6]	N/A
5.1 Furnace Manufacturer & Model: _____	☐	☐	☐
5.2 Furnace Serial #: _____	☐	☐	☐
5.3 Listed Efficiency: _____ AFUE	☐	☐	☐
5.4 Listed Output Heating Capacity: _____ BTUh	☐	☐	☐
5.5 Listed Output Heat. Cap. (Value 5.4) is 100-140% of Design Total Heat Loss (Value 2.15) or next nom. size [8,19]	☐	☐	☐
6. Refrigerant Tests - *Run system for 15 minutes before testing* Note: If outdoor ambient temperature at the condenser is ≤ 55°F or, if known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, and the contractor shall mark "N/A" on the Checklist for Section 6 & 7. [20]			
6.1 Outdoor ambient temperature at condenser: ___ °F DB		☐	☐
6.2 Return-side air temperature inside duct near evaporator, during cooling mode: ___ °F WB		☐	☐
6.3 Liquid line pressure: ___ psig		☐	☐
6.4 Liquid line temperature: ___ °F DB		☐	☐
6.5 Suction line pressure: ___ psig		☐	☐
6.6 Suction line temperature: ___ °F DB		☐	☐
7. Refrigerant Calculations			
For System with Thermal Expansion Valve (TXV):			
7.1 Condenser saturation temperature: ____ °F DB (Using Value 6.3)		☐	☐
7.2 Subcooling value: ____ °F DB (Value 7.1 - Value 6.4)		☐	☐
7.3 OEM subcooling goal: ____ °F DB		☐	☐
7.4 Subcooling deviation: ____ °F DB (Value 7.2 – Value 7.3)		☐	☐
For System with Fixed Orifice:			
7.5 Evaporator saturation temperature: ____ °F DB (Using Value 6.5)		☐	☐
7.6 Superheat value: ____ °F DB (Value 6.6 – Value 7.5)		☐	☐
7.7 OEM superheat goal: ____ °F DB (Using superheat tables and Values 6.1 & 6.2)		☐	☐
7.8 Superheat deviation: ____ °F DB (Value 7.6 – Value 7.7)		☐	☐
7.9 Value 7.4 is ± 3°F or Value 7.8 is ± 5°F		☐	☐
7.10 An OEM test procedure has been used in place of sub-cooling or super-heat process and documentation has been attached that defines this procedure		☐	☐
8. Electrical Measurements – *Taken at electrical disconnect while component is in operation*			
8.1 Evaporator / air handler fan: ___ amperage _____line voltage		☐	☐
8.2 Condenser unit: ___ amperage _____line voltage		☐	☐
8.3 Electrical measurements within OEM-specified tolerance of nameplate value		☐	☐
9. Air Flow Tests			
9.1 Air volume at evaporator: _____ CFM		☐	☐
9.2 Test performed in which mode? ☐ Heating ☐ Cooling		☐	☐
9.3 Return duct static pressure: _____ IWC Test Hole Location: [21] _____		☐	☐
9.4 Supply duct static pressure: _____ IWC Test Hole Location: [21] _____		☐	☐
9.5 Test hole locations are well-marked and accessible [21]		☐	☐
9.6 Measurement method used: ☐ Anemometer ☐ Pressure matching [22] ☐ Flow grid ☐ Fan curve ☐ Other: _____		☐	☐
9.7 Airflow volume at evaporator (Value 9.1), at fan design speed and full operating load, ± 15% of the airflow required per system design (Value 2.16) or within range recommended by OEM		☐	☐
10. Air Balance			
10.1 Individual room airflows within the greater of ± 20% or 25 CFM of the design / application for the supply & return ducts [23]		☐	☐
10.2 Balancing report indicating, for each supply and return register: room name, design airflow, and final measured airflow		☐	☐
11. System Controls			
11.1 Operating and safety controls meet OEM requirements		☐	☐
12. Drain pan			
12.1 Corrosion-resistant drain pan, properly sloped to drainage system, included with each HVAC component that produces condensate [24]		☐	☐

HVAC Contractor Name: _____ HVAC Contractor Signature: _____ Date: _____
Builder Name: [25] _____ Builder Signature: [25] _____ Date: _____

- Refrigerant Test
  - Proper charge
- Refrigerant calculations
  - Sub-cooling / super-heat
- Electrical Measurements
  - Evaporator, condenser, compressor Fan amps, volts, watts
- Air flow tests
  - Flow across the coil (Flow Plate)
  - Static Pressure
- Air Balancing
  - Flow hood ± 20% or 25 CFM of design
  - Balancing Report
- System controls
- Drain pan installation

- HVAC Contractor sign off

Follows ACCA Standard 5 HVAC Quality Installation Specification



- Ventilation requirements (per QI §3.1),
- Heat-gain and heat-loss load calculations (per QI §3.2),
- Properly-sized HVAC equipment (per QI §3.3),
- Ground heat exchangers (per QI§3.4),
- Properly matched systems (per QI §3.5),
- Airflow through the indoor heat exchanger (per QI §4.1),
- Water flow through the indoor heat exchanger (per QI §4.2),
- Refrigerant charge (per QI §4.3),
- Electrical requirements (per QI §4.4),
- Combustion equipment is “on-rate” (per QI §4.5),
- Venting of combustion gases (per QI §4.6),
- System operational and safety controls (per QI §4.7),
- Air ducts are sealed (CFM) (per QI §5.1),
- Room airflow (per QI §5.2),
- Water flow (per QI §5.3),
- Customer documentation (per QI §6.1), and
- Owner and/or operator education (per QI §6.2).

ACCA QUALITY ASSURED HVAC

HVAC System Quality Installation Rater Checklist - page one

- Collect and Review
  - HVAC Contractor Checklist
  - Ventilation System Design
  - Full Load calculations
  - AHRI Certificates
  - Balancing report
  - Rater measured static pressures
- Duct quality installation
  - HVAC and ventilation ductwork emphasis on Flex duct
  - No building cavities / How well are the ducts run
  - Room pressure balancing
  - 1sq" net free area per 1 CFM
- Duct insulation
  - Trunks lines and boots
- Duct leakage
  - Total and to outside if ducts are located outside

ENERGY STAR Qualified Homes, Version 3 (Rev. 05)
HVAC System Quality Installation Rater Checklist [1]

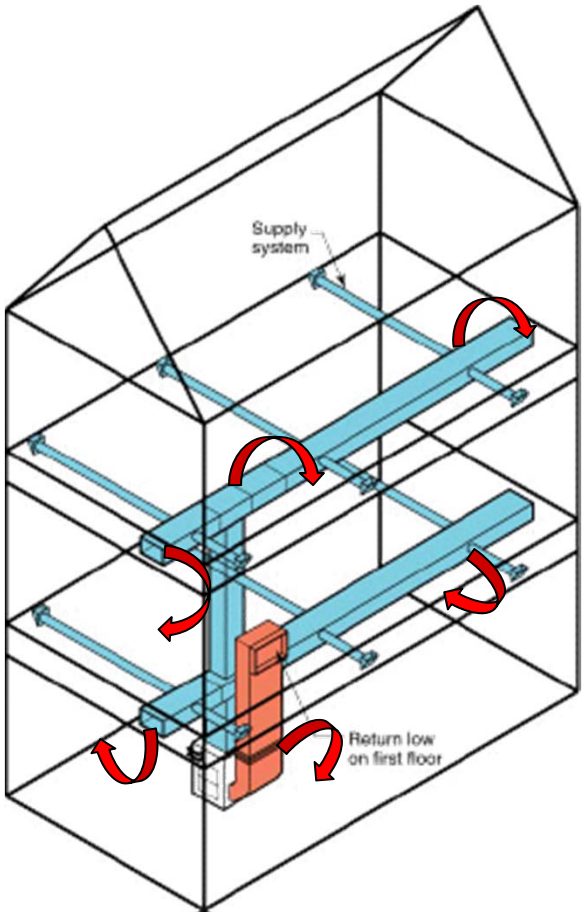
Home Address:_____ City:_____ State:_____

Inspection Guidelines	Must Correct	Rater Verified	N/A
1. Review of HVAC System Quality Installation Contractor Checklist [2]			
1.1 HVAC System Quality Installation Contractor Checklist completed in its entirety and collected for records, along with documentation on ventilation system (1.3), full load calculations (2.18), AHRI certificate (3.15), and balancing report (10.2).	☐	☐	☐
1.2 Review the following parameters related to system cooling design, selection, and installation from the HVAC Contractor Checklist (Contractor Checklist Item # indicated in parenthesis):[3]			
1.2.1 Outdoor design temperatures (2.4) are equal to the 1% and 99% ACCA Manual J design temperatures for contractor-designated design location [4]	☐	☐	☐
1.2.2 Home orientation (2.5) matches orientation of rated home	☐	☐	☐
1.2.3 Number of occupants (2.6) equals number of occupants in rated home [5]	☐	☐	☐
1.2.4 Conditioned floor area (2.7) is within ±10% of conditioned floor area of rated home	☐	☐	☐
1.2.5 Window area (2.8) is within ±10% of calculated window area of rated home	☐	☐	☐
1.2.6 Predominant window SHGC (2.9) is within 0.1 of predominant value in rated home [6]	☐	☐	☐
1.2.7 Listed latent cooling capacity (3.10) exceeds design latent heat gain (2.12)	☐	☐	☐
1.2.8 Listed sensible cooling capacity (3.11) exceeds design sensible heat gain (2.13)	☐	☐	☐
1.2.9 Listed total cooling capacity (3.12) is 95-115% (or 95-125% for Heat Pumps in Climate Zones 4-8) of design total heat gain (2.14), or next nominal size [7]	☐	☐	☐
1.2.10 HVAC manufacturer and model numbers on installed equipment, Contractor Checklist (3.1, 3.3, 5.1), and AHRI certificate or OEM catalog data all match [8]	☐	☐	☐
1.2.11 Using reported liquid line (6.3) or suction line (6.5) pressure, corresponding temp. (as determined using pressure / temperature chart for refrigerant type) matches reported condenser (7.1) or evaporator (7.5) saturation temperature (± 3 degrees) [9]	☐	☐	☐
1.2.12 Calculated subcooling (7.1 minus 6.4) or superheat (6.6 minus 7.5) value equals reported target subcooling (7.3) or superheat (7.7) temperature [9]	☐	☐	☐
1.3 Rater-verified supply & return duct static pressure ≤ 110% of contractor values (9.3, 9.4)	☐	☐	☐
2. Duct Quality Installation - *Applies to All Heating, Cooling, Ventilation, Exhaust, and Pressure Balancing Ducts* [10]			
2.1 Connections and routing of ductwork completed without kinks or sharp bends. [11]	☐	☐	☐
2.2 No excessive coiled or looped flexible ductwork. [12]	☐	☐	☐
2.3 Flexible ducts in unconditioned space not installed in cavities smaller than outer duct diameter; in conditioned space not installed in cavities smaller than inner duct diameter	☐	☐	☐
2.4 Flexible ducts supported at intervals as recommended by mfr. but at a distance ≤ 5 ft.	☐	☐	☐
2.5 Building cavities not used as supply or return ducts unless they meet Items 3.2, 3.3, 4.1, and 4.2 of this Checklist.	☐	☐	☐
2.6 HVAC ducts, cavities used as ducts, and combustion inlets and outlets may pass perpendicularly through exterior walls but shall not be run within exterior walls unless at least R-6 continuous insulation is provided on exterior side of the cavity, along with an interior and exterior air barrier where required by the Thermal Enclosure System Rater Checklist.	☐	☐	☐
2.7 Quantity & location of supply and return duct terminals match contractor balancing report. [10]	☐	☐	☐
2.8 Bedrooms pressure-balanced using any combination of transfer grills, jump ducts, dedicated return ducts, and / or undercut doors to either: a) provide 1 sq. in. of free area opening per 1 CFM of supply air, as reported on the contractor-provided balancing report; or b) achieve a Rater-measured pressure differential ≤ 3 Pa (0.012 in. w.c.) with respect to the main body of the house when all bedroom doors are closed and all air handlers are operating. [10,13,14]	☐	☐	☐
3. Duct Insulation - *Applies to All Heating, Cooling, Supply Ventilation, and Pressure Balancing Ducts* [15]			
3.1 All connections to trunk ducts in unconditioned space are insulated.	☐	☐	☐
3.2 *Prescriptive Path*: Supply ducts in unconditioned attic have insulation ≥ R-8. *Performance Path*: Supply ducts in unconditioned attic have insulation ≥ R-6.	☐	☐	☐
3.3 All other supply ducts and all return ducts in unconditioned space have insulation ≥ R-6.	☐	☐	☐
4. Duct Leakage - *Applies to All Heating, Cooling, and Balanced Ventilation Ducts*			
4.1 Total Rater-measured duct leakage ≤ 8 CFM25 per 100 sq. ft. of conditioned area. [16]	☐	☐	☐
4.2 Rater-measured duct leakage to outdoors ≤ 4 CFM25 per 100 sq. ft. of conditioned floor area. [16,17]	☐	☐	☐

Total Duct leakage (Mandatory)

ESv3 Requirement

- ≤ 8 CFM 25 per 100 sqft of conditioned floor area
- 2000 sqft house ≤ 160 CFM 25 total

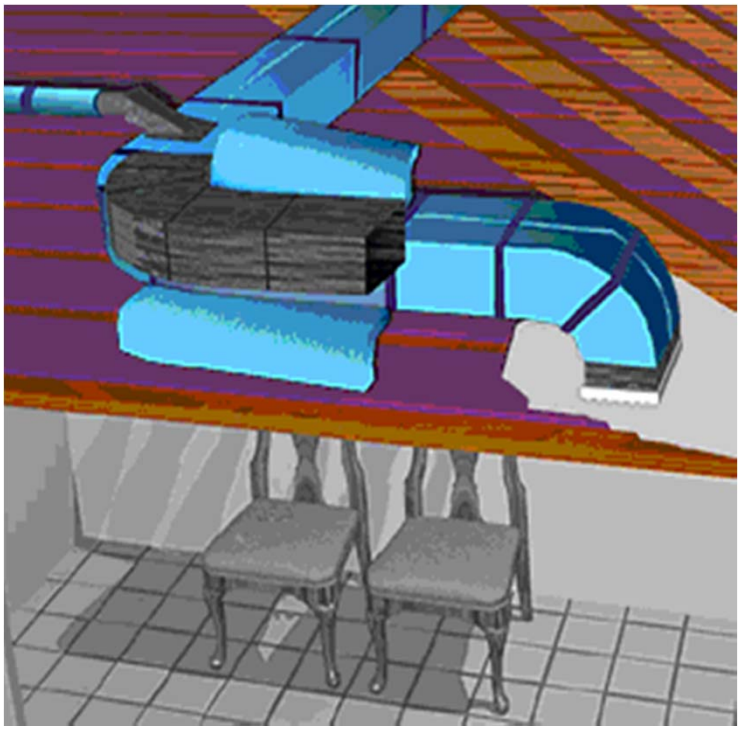


Duct Leakage to Outside

ESv3 requirement

≤ 4 CFM 25 per 100 sqft of conditioned floor area

2000 sqft house ≤ 80 CFM 25 total



HVAC supply and return register boots sealed to subfloor and drywall connected to unconditioned space

HVAC System Quality Installation Rater Checklist page 2

ENERGY STAR Qualified Homes, Version 3 (Rev. 05)
HVAC System Quality Installation Rater Checklist [1]

Inspection Guidelines	Must Correct	Rater Verified	N/A
5. Whole-Building Delivered Ventilation			
5.1 Rater-measured ventilation rate is within 100-120% of HVAC contractor design value (2.11). [18]	☐	☐	☐
6. Controls			
6.1 Air flow is produced when central HVAC fan is energized (set thermostat to "fan").	☐	☐	☐
6.2 Cool air flow is produced when the cooling cycle is energized (set thermostat to "cool"). [19,20]	☐	☐	☐
6.3 Heated air flow is produced when the heating cycle is energized (set thermostat to "heat"). [19]	☐	☐	☐
6.4 Continuously-operating ventilation & exhaust fans include readily accessible override controls.	☐	☐	☐
6.5 Function of ventilation controls is obvious (e.g., bathroom exhaust fan) or, if not, controls have been labeled.	☐	☐	☐
7. Ventilation Air Inlets & Ventilation Source			
7.1 All ventilation air inlets located ≥10 ft. of stretched-string distance from known contamination sources such as stack, vent, exhaust hood, or vehicle exhaust. Exception: ventilation air inlets in the wall ≥ 3 ft. from dryer exhausts and contamination sources exiting through the roof. [21]	☐	☐	☐
7.2 Ventilation air inlets ≥ 2 ft. above grade or roof deck in Climate Zones 1-3 or ≥ 4 ft. above grade or roof deck in Climate Zones 4-8 and not obstructed by snow, plantings, condensing units or other material at time of inspection. [22]	☐	☐	☐
7.3 Ventilation air inlets provided with rodent / insect screen with ≤ 0.5 inch mesh. [23]	☐	☐	☐
7.4 Ventilation air comes directly from outdoors, not from adjacent dwelling units, garages, crawlspaces, or attics.	☐	☐	☐
8. Local Mechanical Exhaust			
In each kitchen and bathroom, a system shall be installed that exhausts directly to the outdoors and meets one of the following Rater-measured airflow standards: [18,24,25]			
Location / Continuous Rate / Intermittent Rate [26]			
8.1 Kitchen — ≥ 5 ACH, based on kitchen volume [27]			
8.2 Bathroom — ≥ 20 CFM			
8.3 If fans share common exhaust duct, back-draft dampers installed.			
8.4 Common exhaust duct not shared by fans in separate dwellings. [29]			
8.5 Clothes dryers vented directly to outdoors, except for ventless dryers ed			
9. Ventilation & Exhaust Fan Ratings (Exemptions for HVAC and R			
9.1 Intermittent supply and exhaust fans rated at ≤ 3 sones by mfr. when pr airflow rate required by Section 8 of this Checklist, unless rated flow ≥ 4			
9.2 Continuous supply & exhaust fans rated at ≤ 1 sone by mfr. when produ required by Section 8 of this Checklist.			
9.3 Bathroom fans used as part of a whole-house mechanical ventilation sy qualified; unless rated flow rate ≥ 500 CFM.			
10. Combustion Appliances			
10.1 Furnaces, boilers, and water heaters located within the home's pressu or direct-vented. As an exception, naturally drafted equipment is allowe drafted furnaces, boilers, and water heaters, the Rater has followed RE procedures and met the selected standard's limits for depressurization concentration in ambient air, as well as a CO concentration in the flue			
10.2 For fireplaces that are not mechanically drafted or direct-vented to out the two largest exhaust fans (excluding summer cooling fans) is ≤ 15 C when at full capacity or the Rater has verified that the pressure differer RESNET's worst-case depressurization test procedure. [24,32,33,34,35]			
10.3 If unvented combustion appliances other than cooking ranges are loca boundary, the Rater has operated the appliance for at least 10 minutes does not exceed 35 ppm. [36]			
11. Filtration			
11.1 At least one MERV 6 or higher filter installed in each ducted mechanic			
11.2 All return air and mechanically supplied outdoor air pass through filter			
11.3 Filter located and installed so as to facilitate access and regular servic			
11.4 Filter access panel includes gasket or comparable sealing mechanism edge of filter when closed to prevent bypass. [39]			

Rater Name: _____ Date C

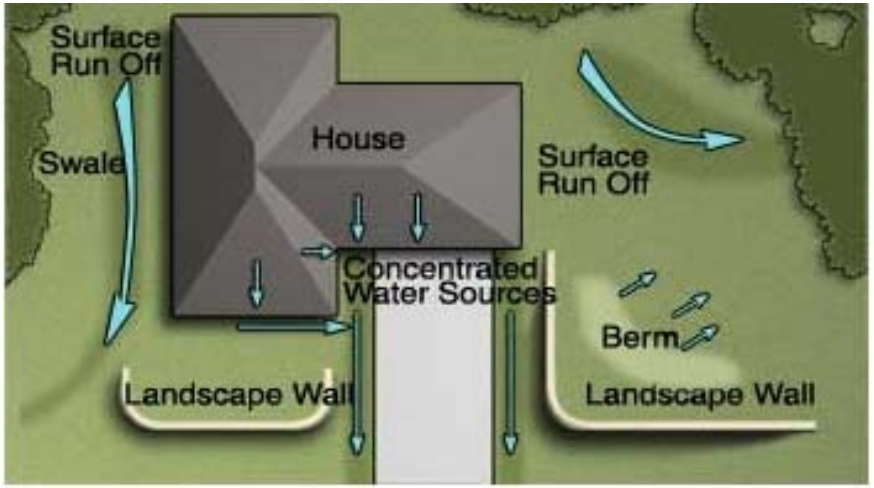
Rater Signature: _____ Rater C

- Whole building ventilation
  - Measured and compared to design
- Ventilation Controls
  - Capable of continuous operation / labeled
- Air inlets and ventilation source
  - Placement to ensure the freshest air
- Spot ventilation
  - Measured flow
  - Dryer vented to outdoors
- Ventilation Fan Rating
  - **Sone rating**
  - Energy Star qualified fans
- Sealed or power vented appliances
  - If located inside thermal boundary
  - Vented fireplace back draft issue
- Filtration- MERV 6 or greater

Water Management

Houses get wet let them dry

Drain away from the house



Water Management System Builder Checklist

1. Water managed site and foundation
   - Grading and walk way slope
   - Capillary Breaks under concrete slabs
     - Not required in Dry Climate Zone B
   - Insulated and damp proofed concrete walls
   - Sealed sump pump lids
   - Clean gravel and fabric filter on drain tile
2. Water managed Wall assembly
   - Proper drainage plane, window and door flashing, and weep holes and screed

ENERGY STAR Qualified Homes, Version 3 (Rev. 05)
Water Management System Builder Checklist [1,2,3]

Home Address: _____ City: _____ State: _____

Inspection Guidelines	Must Correct	Builder Verified	Rater Verified	N/A
1. Water-Managed Site and Foundation				
1.1 Patio slabs, porch slabs, walks, and driveways sloped ≥ 0.25 in. per ft. away from home to edge of surface or 10 ft., whichever is less. [4]	☐	☐	☐	☐
1.2 Back-fill has been tamped and final grade sloped ≥ 0.5 in. per ft. away from home for ≥ 10 ft. See footnote for alternatives. [4]	☐	☐	☐	☐
1.3 Capillary break beneath all slabs (e.g., slab on grade, basement slab) except crawlspace slabs using either: ≥ 6 mil polyethylene sheeting, lapped 6-12 in., or ≥ 1" extruded polystyrene insulation with taped joints. [5]	☐	☐	☐	☐
1.4 Capillary break at all crawlspace floors using ≥ 6 mil polyethylene sheeting, lapped 6-12 in., and installed using one of the following three options: [5]				
1.4.1 Placed beneath a concrete slab; OR,	☐	☐	☐	☐
1.4.2 Lapped up each wall or pier and fastened with furring strips or equivalent; OR,	☐	☐	☐	☐
1.4.3 Secured in the ground at the perimeter using stakes.	☐	☐	☐	☐
1.5 Exterior surface of below-grade walls finished as follows: • For poured concrete, concrete masonry, and insulated concrete forms, finish with damp-proofing coating. • For wood framed walls, finish with polyethylene and adhesive or other equivalent waterproofing.	☐	☐	☐	☐
1.6 Class 1 vapor retarders not installed on the interior side of air permeable insulation in exterior below-grade walls. [6]	☐	☐	☐	☐
1.7 Sump pump covers mechanically attached with full gasket seal				
1.8 Drain tile surrounded with clean gravel and fabric filter. [7]				
2. Water-Managed Wall Assembly				
2.1 Flashing at bottom of exterior walls with weep holes included f stucco cladding systems, or equivalent drainage system.				
2.2 Fully sealed continuous drainage plane behind exterior claddin Additional bond-break drainage plane layer provided behind all cladding wall assemblies. [8]				
2.3 Window and door openings fully flashed. [9]				
3. Water-Managed Roof Assembly				
3.1 Step and kick-out flashing at all roof-wall intersections, extendi and integrated with drainage plane above. [10]				
3.2 For homes that don't have a slab-on-grade foundation and do gutters & downspouts provided that empty to lateral piping that 5 ft. from foundation or to underground catchment system ≥ 10				
3.3 Self-sealing bituminous membrane or equivalent at all valleys				
3.4 In 2009 IECC Climate Zones 5 and higher, self-sealing bitumin sheathing at eaves from the edge of the roof line to > 2 ft. up r exterior wall. [12]				
4. Water-Managed Building Materials				
4.1 Wall-to-wall carpet *not* installed within 2.5 ft. of toilets, tubs, an				
4.2 Cement board or equivalent moisture-resistant backing materi shower enclosures composed of tile or panel assemblies with shall not be used. [13]				
4.3 In Warm-Humid climates, Class 1 vapor retarders not installed insulation in above-grade walls, except at shower and tub walls				
4.4 Building materials with visible signs of water damage or mold				
4.5 Interior walls *not* enclosed (e.g., with drywall) if either the frami have high moisture content. [15]				

Builder Employee: _____
Builder Signature: _____

Builder has completed Builder Checklist in its entirety, except for it
Rater Signature: _____

Water Management System Builder Checklist

3. Water managed Roof Assembly

- Step and kick flashing
- Down spouts
- Self sealing membranes at valleys and roof deck penetrations (Peal and Stick)
  - Dry Climate zone B exception
- ≥ Climate Zone 5: Self sealing membranes over sheathing at eaves
  - Dry Climate zone B exception

4. Water Managed Building Materials

- No wall to wall carpet in wet areas
- None paper based moisture resistant backing materials in moist areas
- Building materials with signs of moisture damage not used
- Drywall not installed over wet framing or insulation materials

ENERGY STAR Qualified Homes, Version 3 (Rev. 05)
Water Management System Builder Checklist [1,2,3]

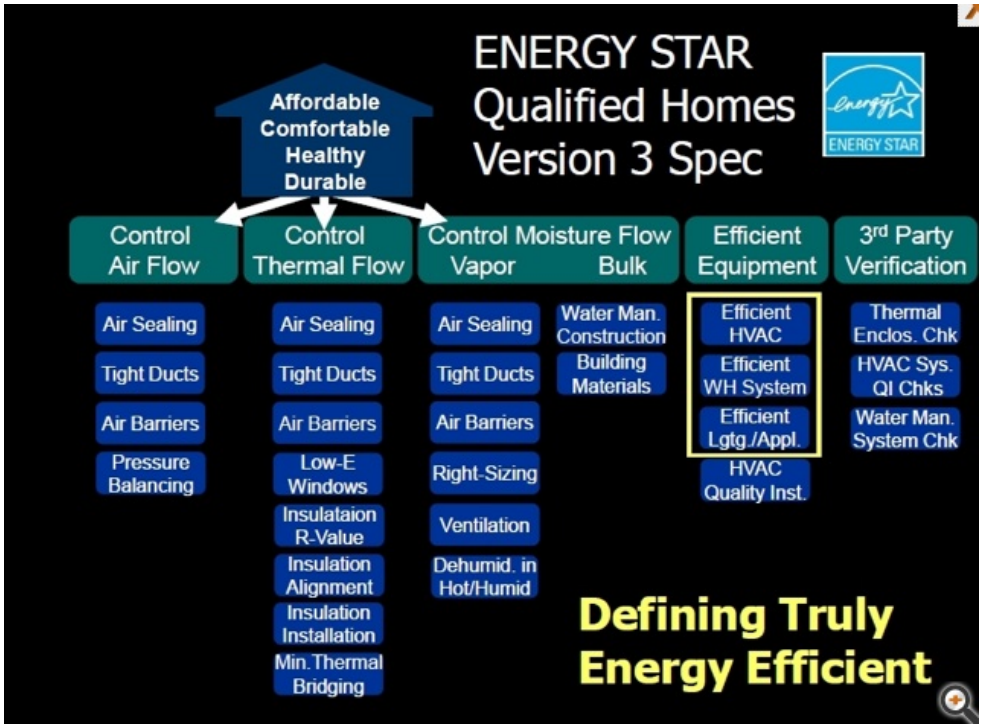
Home Address: _____ City: _____ State: _____

Inspection Guidelines	Must Correct	Builder Verified	Rater Verified	N/A
1. Water-Managed Site and Foundation				
1.1 Patio slabs, porch slabs, walks, and driveways sloped ≥ 0.25 in. per ft. away from home to edge of surface or 10 ft., whichever is less. [4]	☐	☐	☐	☐
1.2 Back-fill has been tamped and final grade sloped ≥ 0.5 in. per ft. away from home for ≥ 10 ft. See footnote for alternatives. [4]	☐	☐	☐	☐
1.3 Capillary break beneath all slabs (e.g., slab on grade, basement slab) except crawlspace slabs using either: ≥ 6 mil polyethylene sheeting, lapped 6-12 in., or ≥ 1" extruded polystyrene insulation with taped joints. [5]	☐	☐	☐	☐
1.4 Capillary break at all crawlspace floors using ≥ 6 mil polyethylene sheeting, lapped 6-12 in., and installed using one of the following three options: [5]				
1.4.1 Placed beneath a concrete slab; OR,	☐	☐	☐	☐
1.4.2 Lapped up each wall or pier and fastened with furring strips or equivalent; OR,	☐	☐	☐	☐
1.4.3 Secured in the ground at the perimeter using stakes.	☐	☐	☐	☐
1.5 Exterior surface of below-grade walls finished as follows: • For poured concrete, concrete masonry, and insulated concrete forms, finish with damp-proofing coating. • For wood framed walls, finish with polyethylene and adhesive or other equivalent waterproofing.	☐	☐	☐	☐
1.6 Class 1 vapor retarders not installed on the interior side of air permeable insulation in exterior below-grade walls. [6]	☐	☐	☐	☐
1.7 Sump pump covers mechanically attached with full gasket seal or equivalent.	☐	☐	☐	☐
1.8 Drain tile surrounded with clean gravel and fabric filter. [7]	☐	☐	☐	☐
2. Water-Managed Wall Assembly				
2.1 Flashing at bottom of exterior walls with weep holes included for masonry veneer and weep screed for stucco cladding systems, or equivalent drainage system.	☐	☐	☐	☐
2.2 Fully sealed continuous drainage plane behind exterior cladding that lap Additional bond-break drainage plane layer provided behind all stucco a cladding wall assemblies. [8]				
2.3				
3. W				
3.1				
3.2				
3.3				
3.4				
4. W				
4.1				
4.2				
4.3				
4.4				
4.5				
Bui Bui				
Bui Rater Signature:				

Indoor Air Plus vs. Water Management Checklist

- **Moisture control**
  - **Water Managed site & foundation**
    - **Drainage, Capillary break, damp proofed, Etc.**
  - **Water managed Wall assemblies**
    - **Drainage plane, flashing details**
  - **Water managed Roof assemblies**
    - **Gutters and flashing**
  - **Interior water management**
    - **Moisture resistant materials**
- **Radon control**
  - Radon resistant features including at least a passive radon system
- **Pest Barriers**
  - Minimize pathway for pests
- **HVAC Systems**
  - **Heating & Cooling equipment**
    - **Sizing and design**
  - **Ventilation**
    - **ASHREA 62.2**
  - **Air cleaning and filtration**
  - **Dehumidification**
- **Combustion pollutant control**
  - **Combustion source Controls**
    - **Sealed or power vented equipment**
  - Attached garages
    - Insolated
- **Low emission materials**
  - Engineered woods, Paints, Carpets
- **Home commissioning**
  - **Duct testing, Pressure balancing, Flows, Etc.**

Applied Building Science and Systems Thinging Meeting the Energy Star Mission

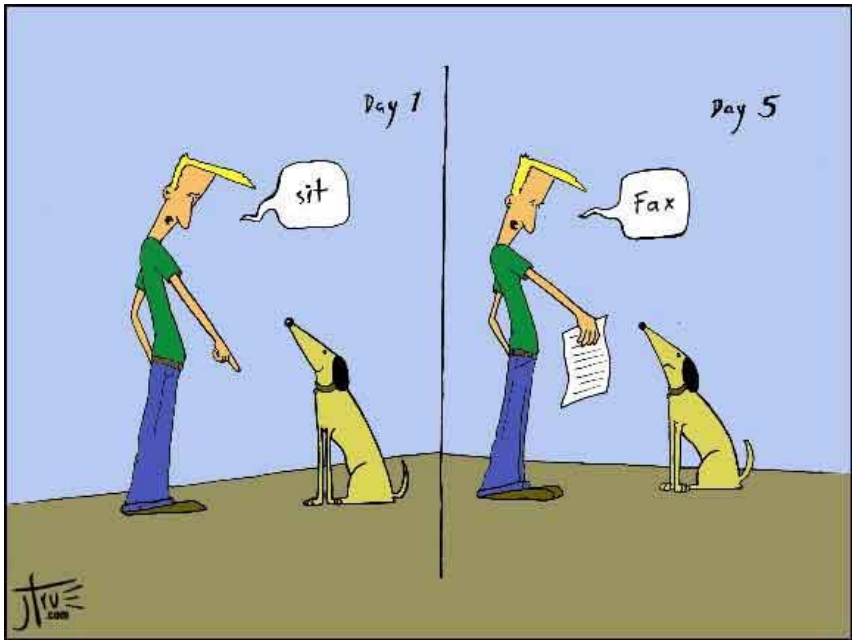


- Performance Path
- Thermal Enclosure Checklist
- HVAC Quality Installation Checklists
- Water Management Systems Checklist

How to move Forward

Training

- Become a Partner
  - Builder training
    - Online
    - Sales Training
  - Rater Training
    - Must be completed before working on ESv3 houses
  - HVAC Contractor
    - Required credentialing to work on an ESv3 Homes
- Learn the details
  - Reed & study the checklists



3	FULLY-ALIGNED AIR-BARRIERS
1	WALLS
5	GARAGE RIM/BAND JOIST ADJOINING CONDITIONED SPACE

Checklist Reference

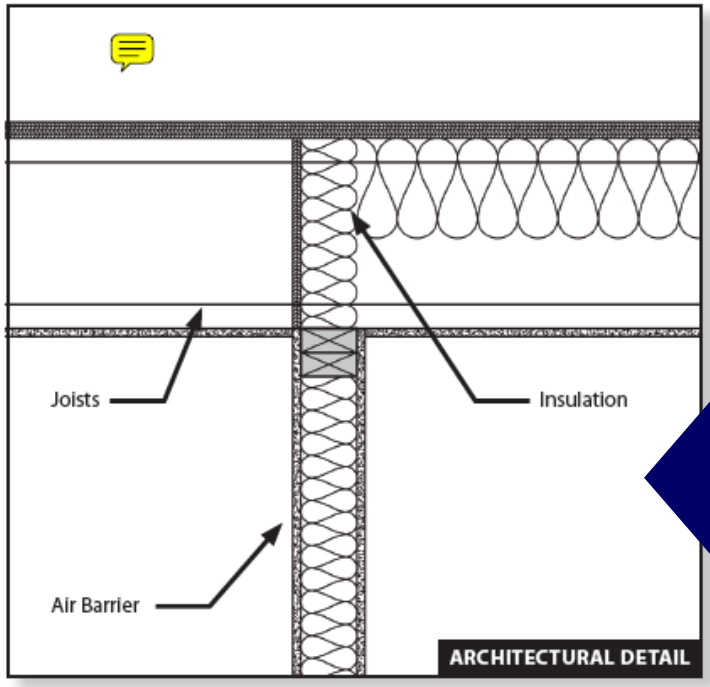
ENERGY STAR

SECTION 3: FULLY ALIGNED BARRIERS

At each location noted below, a complete air barrier shall be provided that is fully aligned with the insulation as follows:

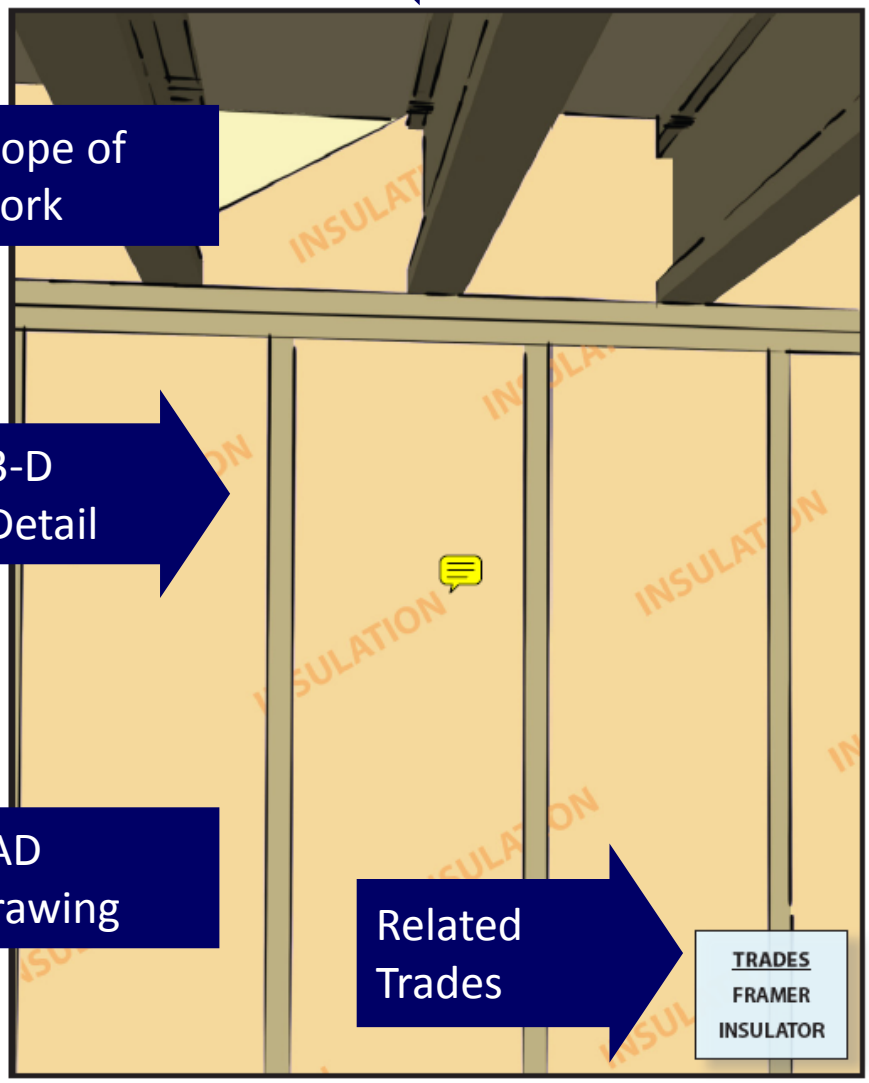
- At interior surface of ceilings in all climate zones
- At exterior surface of walls in all climate zones; and, for Climate Zones 4-8 only, also at interior surface of walls
- At interior surface of floors in all climate zones, including supports to ensure permanent contact and blocking at exposed edges

Scope of Work



3-D Detail

CAD Drawing



Related Trades

A. Duct is kinked in cavity.

Duct is run straight and supported properly.

B. Ducts crammed into cavity, kinked and sharply bent.

Ducts are run straight and supported properly.

C. Excessive length of duct installed causing sharp bends.

Fan housing was oriented in the correct direction to allow proper exhaust duct installation.

DUCT AIR FLOW BASICS

- Each turn, kink, or compression of duct work reduces air flow.
- If the recommended amount of air flow is not delivered to the room, it could lead to homeowner comfort complaints.

DUCT AIR FLOW TIPS

- To best understand the intent of the HVAC contractor, it is helpful to look at the ducts designed in compliance with Manual D.
- Use balancing dampers in flex ducts to control flow. For metal ducts, butterfly dampers may be used to control air flow.
- To prevent kinks at the duct and boot connection, EPA recommends using metal duct elbow instead of flex duct.
- Webbed trusses between floors allow for ducts to freely pass through the floor system without compromising the structure.

http://www.energystar.gov/homes

Marketing – Telling The Story

How many ways can you touch a buyer?

- Location
- Design
- Amenities
- Options
- Efficiency and Performance
  - Core Values and Expectations of the new home
    - Comfort, Durability, Safety, Sustainability,

How To Explain Energy Star

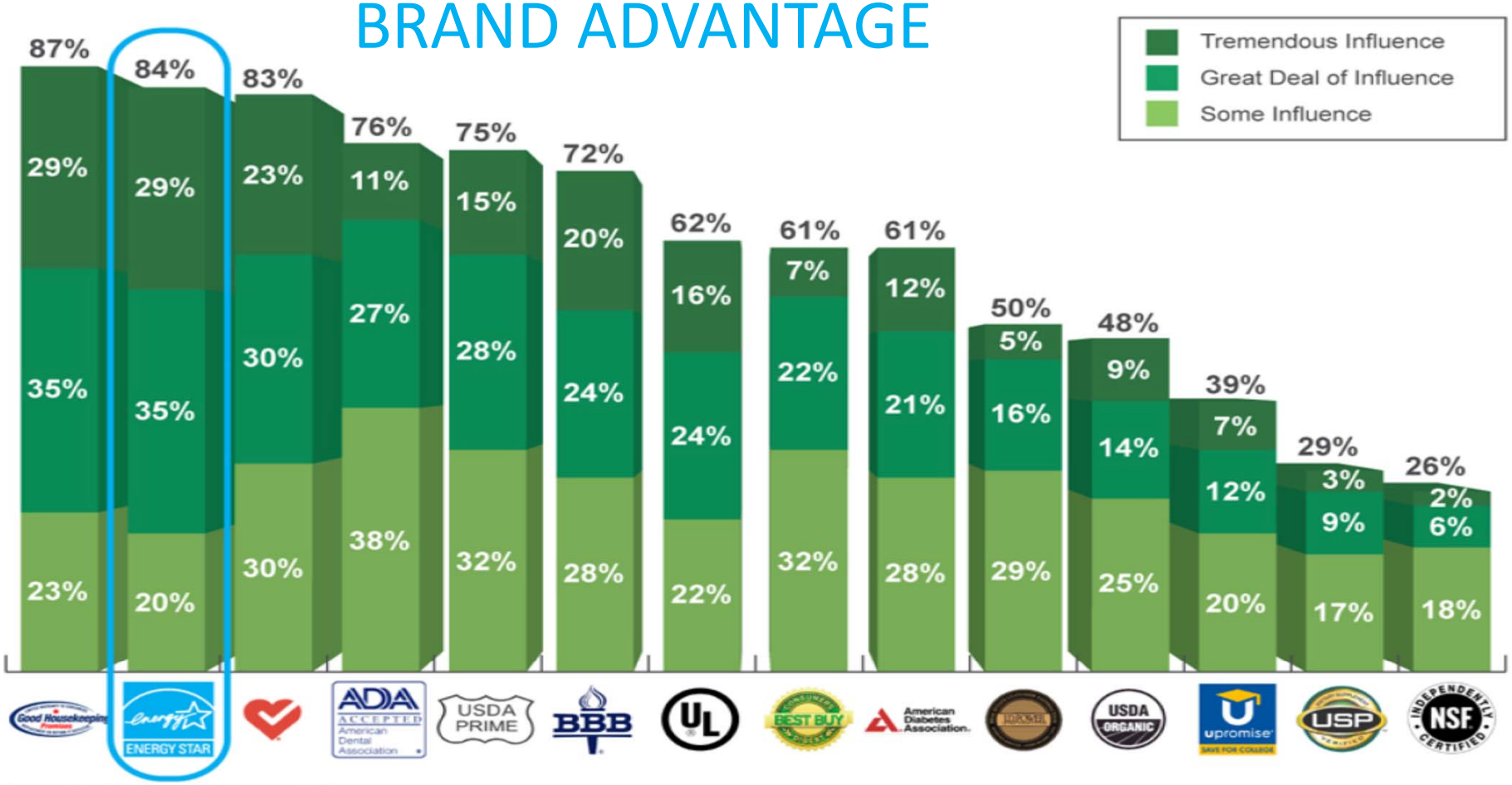
- Setting the stage for your conversation
- Who is your audience
  - Builder
  - Sales Person
  - Buyer

Consistent Branding

ENERGY STAR

About ENERGY STAR

BRAND ADVANTAGE



Source: Fairfield Research, Summer 2007

EPA

The ENERGY STAR mark ranks among the highest level of influence on product purchase among all consumer emblems, similar in ranking to the *Good Housekeeping* Seal.

What's in ENERGY STAR?

Core Energy Efficiency Features

+

Complete Thermal Enclosure System

Complete Heating & Cooling System

Complete Water Management System

=

ENERGY STAR

Peace of mind

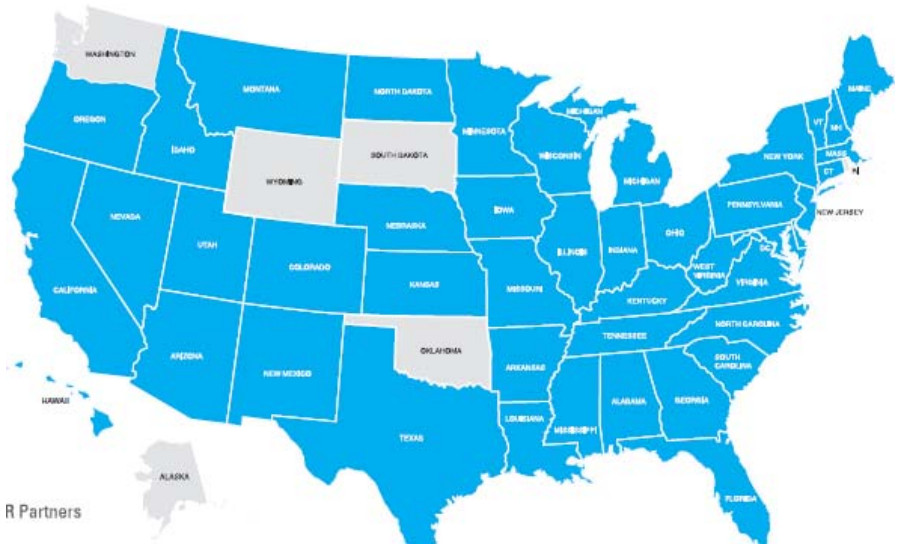
Enduring quality

Wall-to-wall comfort

Proven value

Recognized by > 80% of households

Market Realities



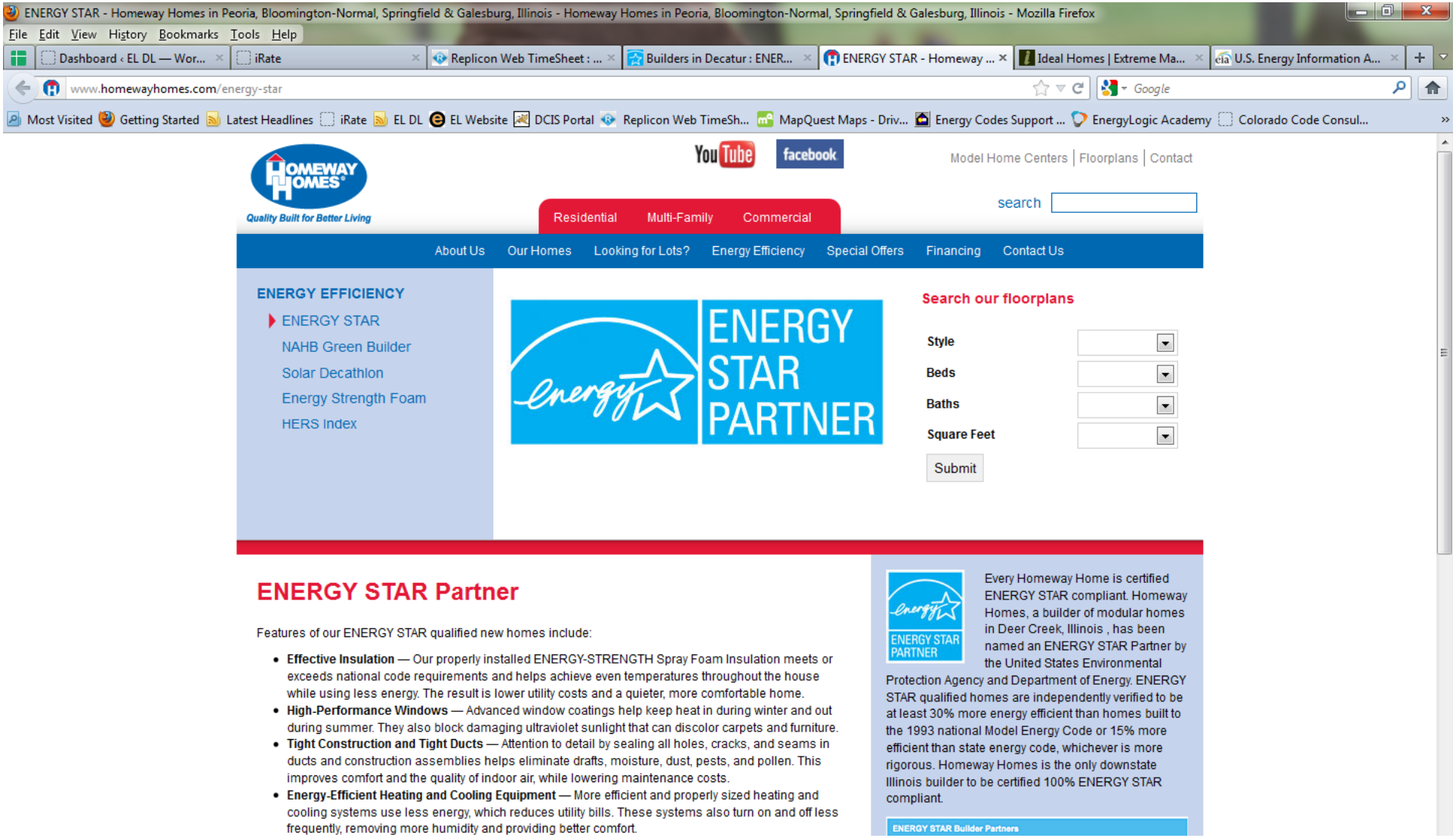
WASHINGTON

- The U.S. Environmental Protection Agency (EPA) announced that of all single-family homes built nationally
- 21% in 2009
- 25% in 2010
- 30% in 2011

- Colorado Market share of ESNHs
  - 2004 - 4.2%
  - 2009 - 28%
  - 2010 - 45%
  - 2011 - 43%
  - 2012 - Going down

Utility Programs

Good in the Past



Marketing the HERS Score

RESNET
Residential Energy Services Network

Setting the STANDARD for QUALITY

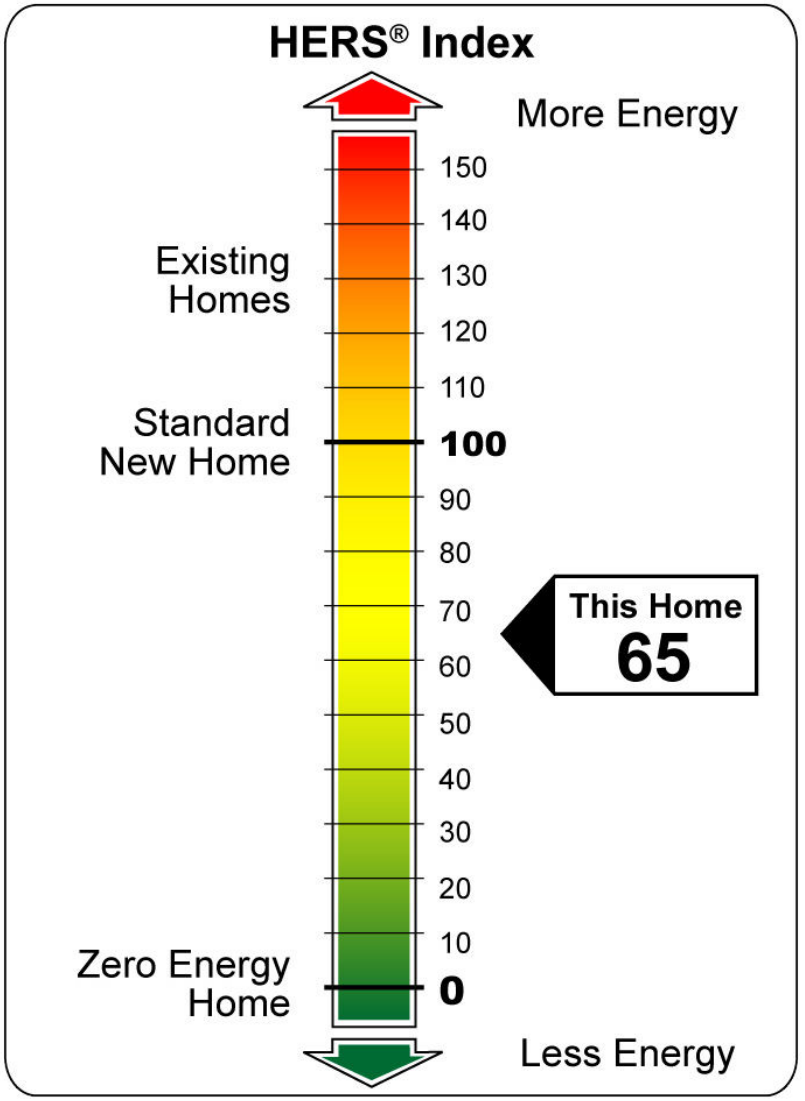
April 13, 2012

Momentum Growing for RESNET HERS Index - New Regional and State Builders Making Commitment to Having All of Their Homes Energy Rated and Marketing Their Homes HERS Index Score in March

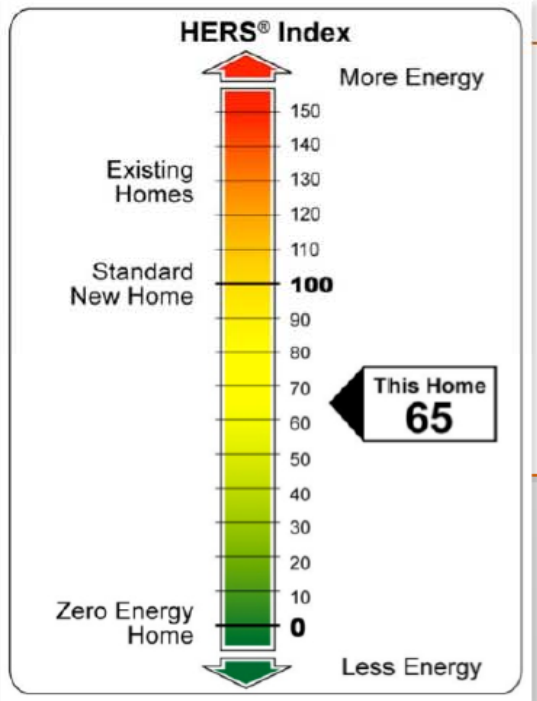
An increasing number of builders are taking advantage of the RESNET HERS Index. Over the past month, builders in states ranging from Michigan to South Carolina have entered into Memorandums of Understanding (MOU) with RESNET. In the MOUs, the builders commit to having their homes energy rated by a certified RESNET rater and marketing their homes' HERS Index Score.

With or Without RESNET

- RESNET Energy Smart Builders are leading the transformation of housing towards high energy performance homes.
- These leading builders are committed to having all of their homes energy rated following RESNET's stringent standards and marketing their homes' HERS Index.



Certification of our ENERGY GUARANTEE



GUARANTEE ENERGY USE ESTIMATES FOR:

1234 Kilowatt Avenue
Loveland, CO 00000

Provided **DECEMBER 14 2011**

Heating: **120 Therms**
Cooling: **60 kWh**

Your Estimated Heating & Cooling Energy Costs are:
$1795 per year

OUR GUARANTEE:

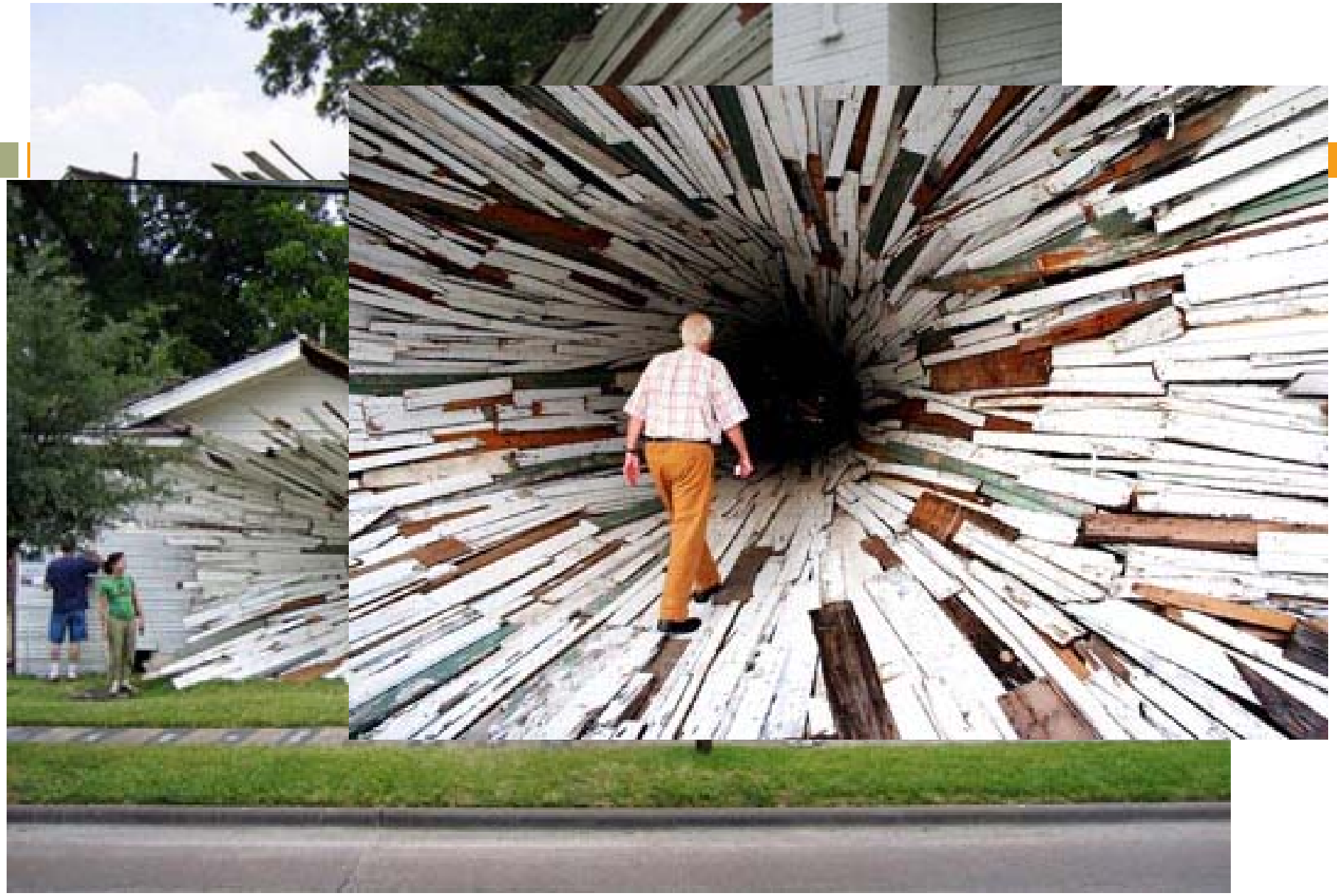
We guarantee the HEATING AND COOLING ENERGY USE indicated above for your home for two (2) years from the date on this certificate.

If your home uses more energy for heating and cooling per year than we predict, ***EnergyLogic will pay the difference.***

IT'S THAT SIMPLE.

For more information and/or make a claim,
please visit: www.nrglogic.com/guarantee or call us at 1.800.315.0459

energyLogic
analysis insight answers



Tunnel House

Energy Star V3

Thank you!

Robby@nrglogic.com

www.nrglogic.com

720-838-0677

Upside down house Szymbark Poland