

IECC

Pathways, Science, and More



Presented by Robby Schwarz



energyLogic Helping Colorado Builders Achieve Peak Performance

Agenda

- Intent of the IECC
- Systems Thinking
- The look and layout of the 2018 IECC
- Pathways through the code



Change is Hard ... Change is Good... Change can be Made Easier

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Expectation



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

- Largest Purchase
- Least knowledge



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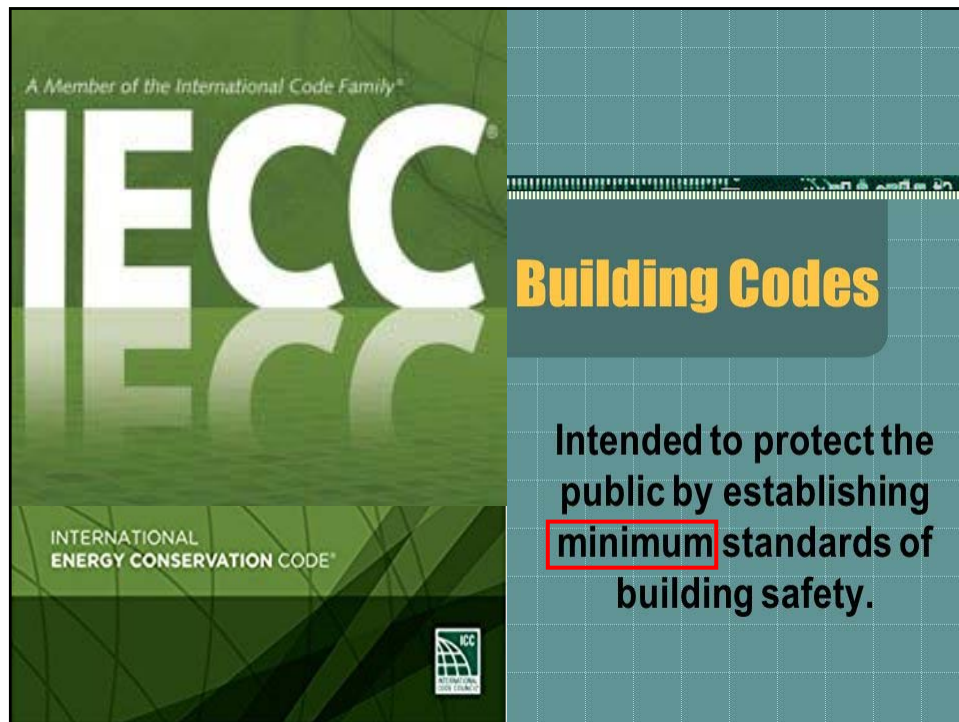


Integrity

Adherence to moral principles
In ethics, integrity is regarded as
the honesty and truthfulness or
uprightness, sincerity, and

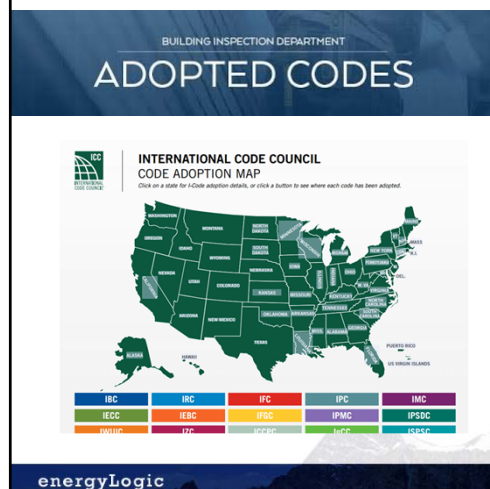
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The key factor of code development

Adoption



Amendment

- a·mend·ment
- ə'men(d)mənt/
- *noun*
- a minor change in a document.
- a change or addition to a legal or statutory document.

A Member of the International Code Family™



INTENT & IMPACT DIFFERENCE

in·tent

/in'tent/ 

noun


- intention or purpose.
 "with alarm she realized his intent"
synonyms: aim, intention, purpose, objective, object, goal, target;






2018 IECC – Intent

This code shall regulate the design and construction of buildings for the effective use and conservation of energy **over the useful life of each building**

- Durability

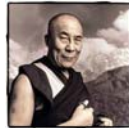


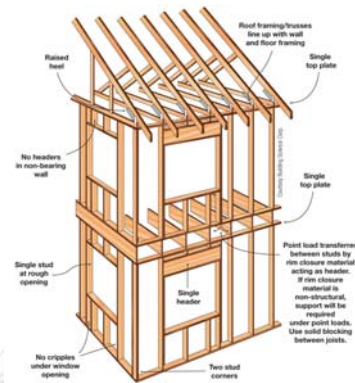
2018 IECC – Intent

This code is intended to **provide flexibility** to permit innovative approaches and techniques to achieve this objective

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



Author: Dalai Lama
Date: Feb 25, 2008

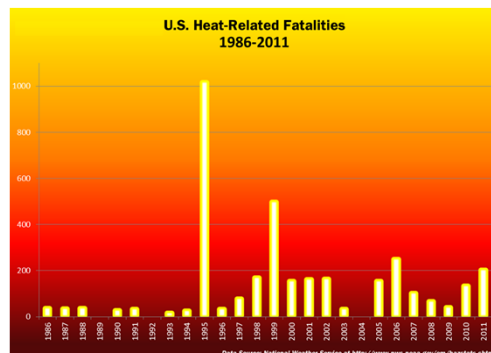


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2018 IECC – Intent

The code is not intended to **abridge safety, health or environmental requirements** contained in other applicable codes or ordinances



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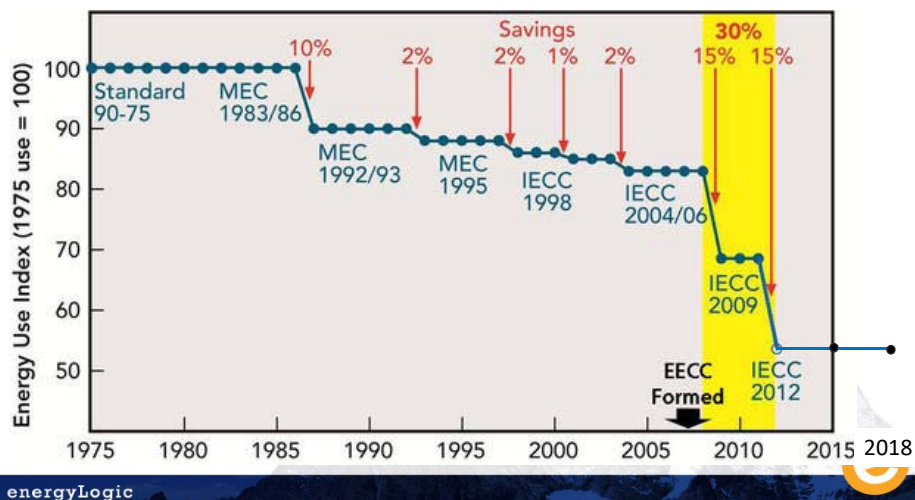




Energy Code

Its not your Daddy's code?

- No longer building the minimum ___ house allowable!



Look how houses have changed



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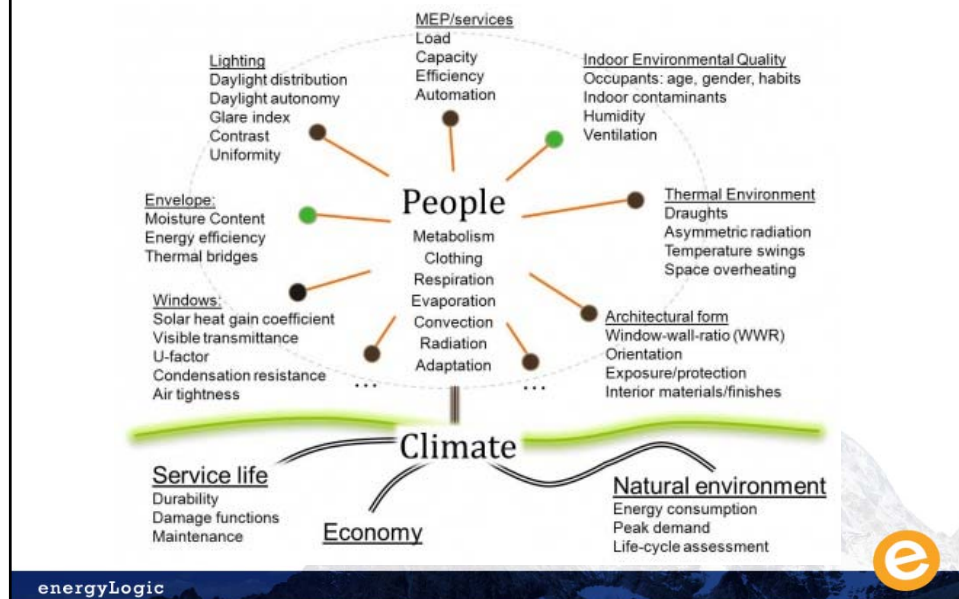


<https://thecraftsmanblog.com/how-to-tell-if-you-have-a-balloon-frame-house/>

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Applied Building Science



Systems Thinking

- Holistic approach rather than a component approach.
- Synergy
 - The various parts work together
 - **Achieving** what could not be achieved before!
- Meeting the Expectations
 - Aesthetics
 - Safe
 - Comfort
 - Durable
 - Efficient
 - Environmental



Synergy = Systems Thinking

- $1+1 = 1$
 - Fan + Duct = Air flow
- $1+1 = 2$
 - Fan + Duct = Air flow + Ventilation
- $1+1 = 3$
 - Fan + Duct = Air flow + Ventilation + Durability
- $1+1 = 4$
 - Fan + Duct = Air flow + Ventilation + Durability + IAQ



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If the House is an Operating System

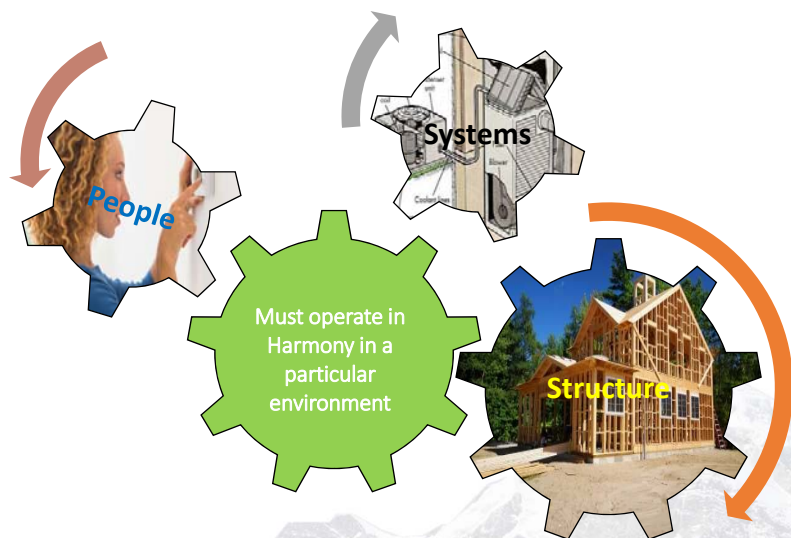
- There are three parts to the system...



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House as a System and Applied Building Science



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People Factors

- What do they care about?
- Expectations
 - Safety
 - Energy Efficiency
 - Durability
 - Sustainability
 - Comfort

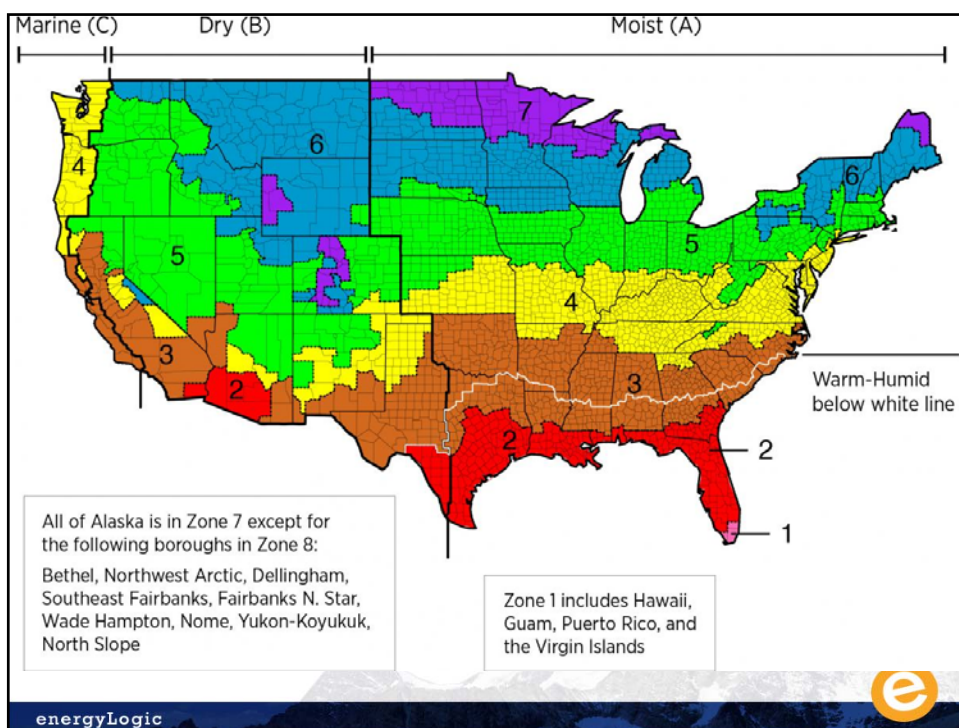


- People = Need for Systems Thinking

How to take the people out of the equation

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Understand

- We are no longer true “builders”
- Leaders of change and innovation
- Understand Systems thinking and applied building science
- Understand performance
- Help educate our trade partners
- Inform the trades of our objectives
- Design – construct – test – review – learn



Warranty

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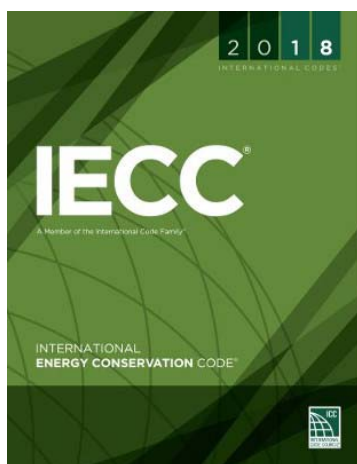
Who is actually using this code?

- Proactive designers
- Market conscience builders
- Building owners who care about their buildings and their costs
- Code Officials who are aware that building owners have expectations
- “When I buy a building I **expect** it to stand through a wind storm. I **expect** my roof to hold the snow load. I **expect** the hot water to be hot and the cold water to be cold. I **expect** the building to be durable and I **expect** my next utility bill will not put me out of my next mortgage payment!”

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The look and layout of the 2018 IECC



The IECC covers both:

- Commercial (CE) chapters 1-6

and

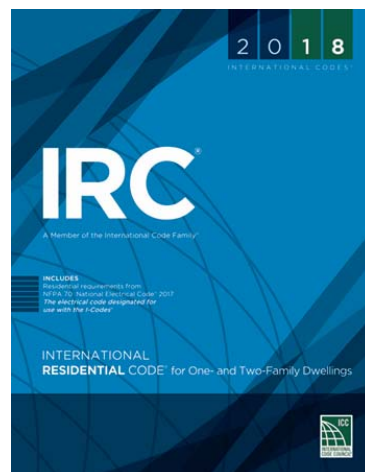
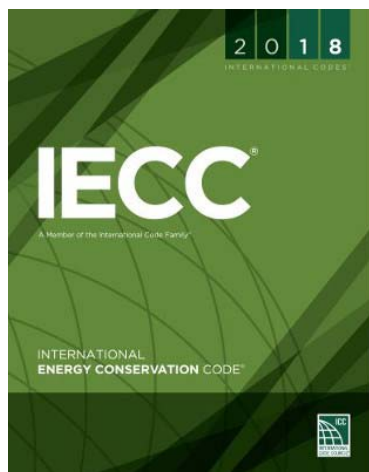
- Residential (RE) chapters 1-6

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2018 Energy Codes

The Residential Provisions of the IECC become the energy provisions (Chapter 11) of the IRC.



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Residential VS Commercial



Definition of Residential per IECC is different than that found in the IRC and IBC:

RESIDENTIAL BUILDING

- For this code, includes detached one- and two family dwellings and multiple single-family dwellings (townhouses) as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane



COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of "Residential buildings."

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Chapter 1: Administration

- Often the Chief Building Official deletes Chapter 1 and inserts their own administrative provisions
- However the IECC has code requirements in Chapter 1 so jurisdictions are more apt to amend this chapter rather than delete it



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New since the 2012

R101.2 Scope

- Starting with the 2012 IECC, in addition to the code applying to residential buildings , it now also applies to the **building sites and associated systems and equipment**



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R102.1

- The Code official shall be permitted to approve an alternative material, design or method of construction where the code official finds that the proposed design is satisfactory and complies with the intent of the provision of this code and that the material, method or work offered is for the purpose intended, at least the equivalent of that prescribed in this code



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R102.1

- The Code official shall be permitted to approve an alternative material, design or method of construction where the code official finds that the proposed design is satisfactory and complies with the intent of the provision of this code and that the material, method or work offered is for the purpose intended, at least the equivalent of that prescribed in this code

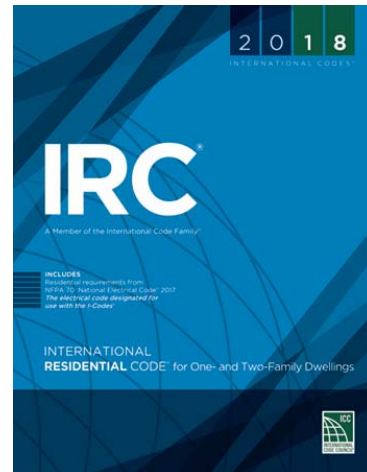


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2018 International Residential Code

Connection to the IECC



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R103.1 General

- Construction documents, technical reports and other supporting data **shall be submitted** in one or more sets **with each application for a permit**.
- The construction documents and technical reports **shall be prepared by a registered design professional** where required by the statutes of the jurisdiction in which the project is to be constructed.
- Where special conditions exist, the *code official* is authorized to require necessary construction documents to be prepared by a registered design professional.

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R103



Construction Documents

- R103.1 General
 - Construction documents prepared by a design professional
 - i.e. set of plans
 - Different from compliance documents

R103.2 Information on Construction documents

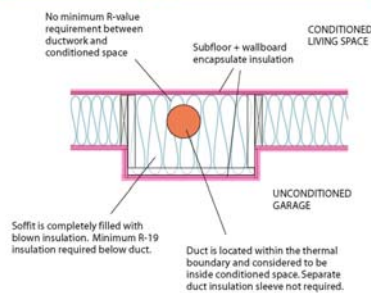
- Details shall include but are not limited to:
 - Insulation location and R-values
 - Window U-value & SHGC
 - Mechanical System design criteria
 - Mechanical and water heater Type, size and efficiency
 - Duct sealing, insulation and location
 - Air sealing details

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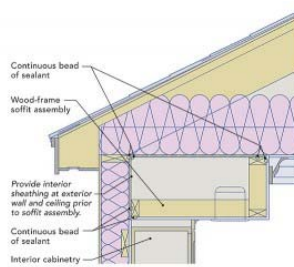
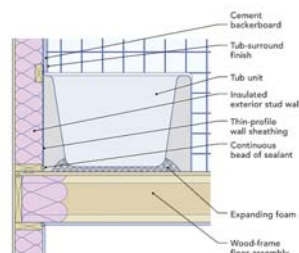
Example Details

Ductwork in floor over garage



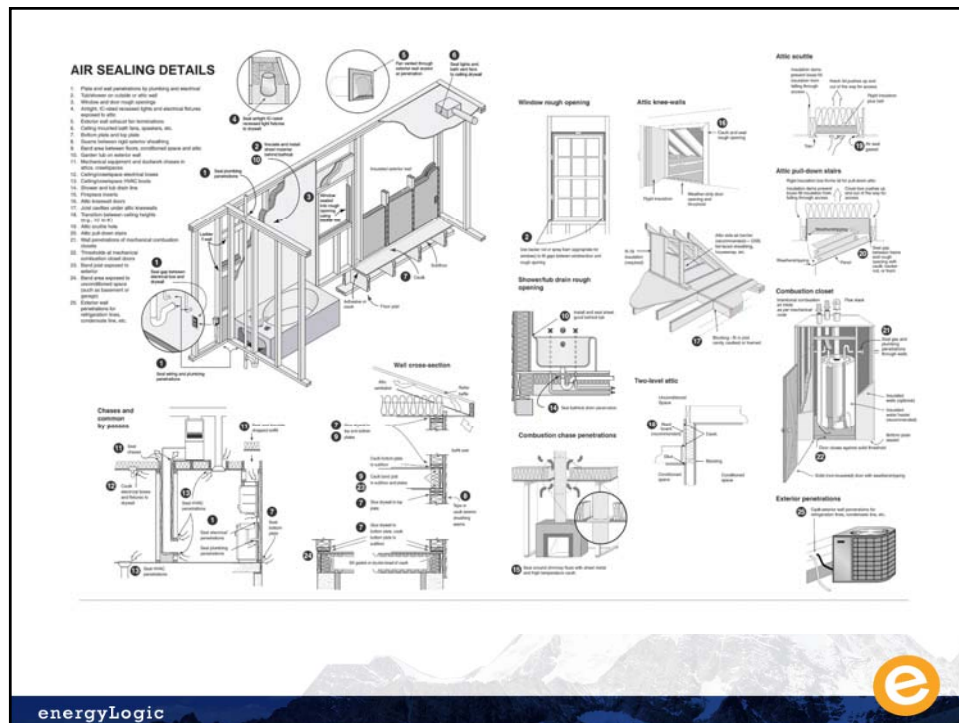
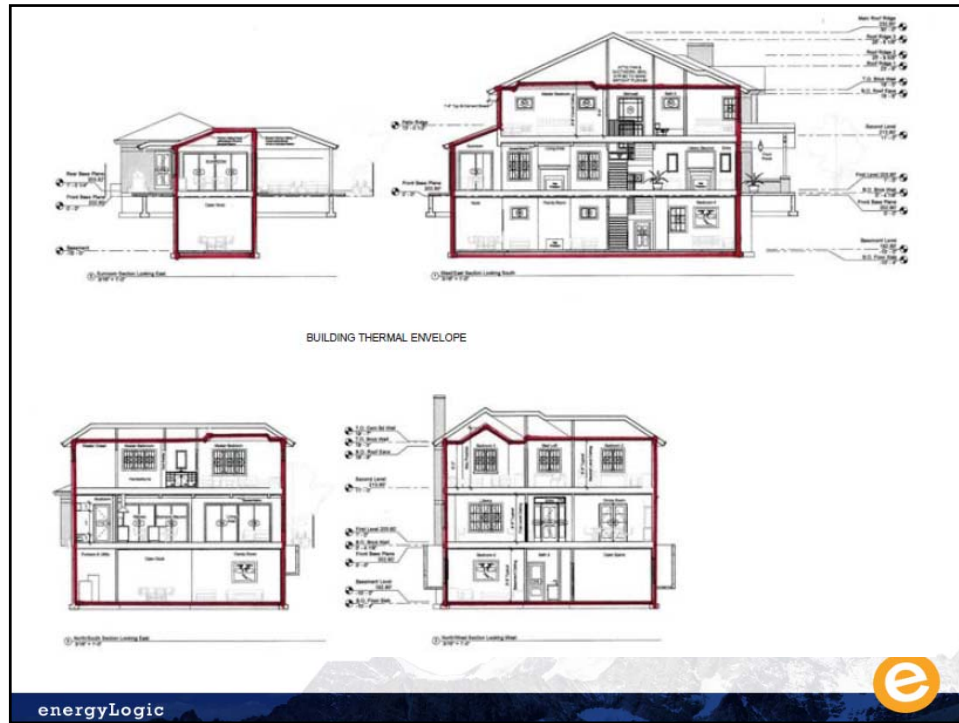
NOTE: This approach is only approved if BLOWN insulation is used to completely fill the soffit.

5/19/2012



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IECC Residential Compliance Report				energyLogic analysis. insight. answers.			
IECC version 2015 as amended							
Component R-values/U-values							
Ceiling		R-value		Doors		R-value	Door Glass U-value
Flat attic		38		To the exterior			0.35 or better
Vaulted Attic		38		To the Garage			unknown (20min solid core wood)
Un accessible Batted		? NA?		Heating System	AFUE	Cooling	SEER
Vented Raftered		38		Basement	96%		Basement
Unvented Raftered		38		Attic			Attic
				other			other 13 whole house (optional)
Wood Framed Walls		R-value		Ductwork/R-value			
2x6		19		Location	assumed to be Code min.		
2x4		NA		Location			
Knee wall		19		Location			
Jim Joist/Box Sill		?					
Party wall/ Adiabatic Wall		13					
Mass Wall		R-value		Hot Water			
Type:		NA		Type	Open combustion / B-vent(Rheem 50gal)		
Floors		R-value		Energy Factor	.59 to .64 UEF		
Cantilever		30 or 19min		Recirculation system type	pump with looped piping		
Floor over garage		30 or 19min		Insulated	per Code if applicable		
Foundation		R-value		Supplemental Heat			
Under Slab				Unvented room heater	NA except vented gas fireplaces		
Slab Edge		10 under edge		Electric heater	NA		
Conditioned Crawl space wall		11 contin below grade		Whole House Controlled Ventilation Type	assume exhaust fan in Laundry		
Vented Crawl space floor		NA					
Unfinished basement wall		14 contin below grade					
Finished basement wall		13					
Windows/skylight	Window	Skylight		Vapor Management: Tight home, spot and whole house ventilation, class III vapor barrier			
Above grade U-val	0.35 or better			EnergyLogic certifies that to the best of our knowledge the information contained on this document is true and complete:	Date:		
Above grade SHGC	0.33						
Below grade U-val	0.35 or better			Printed Name	Signature		
Below grade SHGC	0.33						

ENERGY COMPLIANCE FOR A NEW SINGLE FAMILY RESIDENCE AT 442 SOUTH VINE STREET

- PROJECT SHALL COMPLY WITH THE 2015 IECC RESIDENTIAL PROVISIONS AND THE 2015 IRC, CHAPTER 11
- ALL MANDATORY REQUIREMENTS IN IECC SECTIONS R401 THROUGH R404 AND IRC SECTIONS N1101.14 THROUGH N1104 SHALL BE MET
- COMPLIANCE SHALL BE SHOWN USING METHOD 2 (SIMULATED PERFORMANCE ALTERNATIVE, IECC SECTION R405 AND IRC SECTION N1105)
- THE ENERGY COMPLIANCE SUBMITTAL SHALL INCLUDE:
 - COMPLIANCE REPORT SUBMITTED BY:

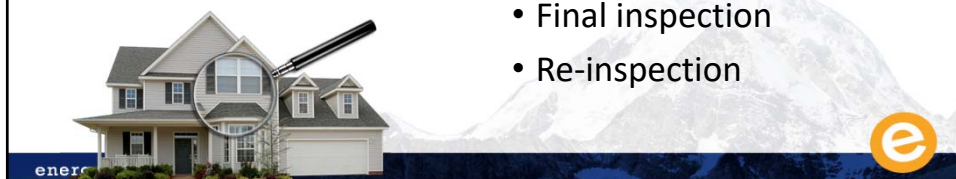
EnergyLogic
Robby Schwarz
720 838 0677
robby@nrglogic.com
3606 West 50th Avenue
Denver, CO 80221
 - ENERGY COMPLIANCE CERTIFICATE, RE: SHEET A101X
 - BUILDING SECTIONS SHOWING THE BUILDING THERMAL ENVELOPE, RE: SHEET A101X
 - AIR SEALING DETAILS AND NOTES, RE: SHEET A101X
 - HVAC MANUALS D, J, AND S
- UPON COMPLETION OF THE BUILDING, A COMPLIANCE REPORT BASED ON THE AS-BUILT CONDITION OF THE BUILDING SHALL BE SUBMITTED TO THE BUILDING OFFICIAL BEFORE A CERTIFICATE OF OCCUPANCY CAN BE ISSUED. THE COMPLIANCE REPORT MUST INCLUDE ALL REQUIREMENTS OUTLINED IN IECC SECTION R405.4.2.2 AND IRC SECTION N1105.4.2.2.
- AS REQUIRED IN IECC SECTION R401.3 AND IRC SECTION N1101.14, A PERMANENT CERTIFICATE SHALL BE COMPLETED BY THE BUILDER AND POSTED ON A WALL IN THE SPACE WHERE THE FURNACE IS LOCATED. THE CERTIFICATE MUST BE POSTED BY THE TIME OF THE PROJECT'S FINAL INSPECTION AND SHALL USE THE INCLUDED ENERGY COMPLIANCE CERTIFICATE FOR POSTING.

PLEASE NOTE: IN ADDITION TO THE AIR SEALING DETAILS SHOWN ON SHEET A101X, THE FOLLOWING CONSTRUCTION METHODS SHALL BE EMPLOYED WHERE APPLICABLE TO COMPLY WITH THE REQUIREMENTS OF IECC R402.1.1 AND R402.2.1:

- 2 OR 3 STUD INSULATED CORNERS
- LADDER BLOCKING WHERE INTERIOR WALLS MEET EXTERIOR WALLS TO FULLY INSULATE THEM
- INSULATED HEADERS
- SEALING THE DRYWALL TO THE TOP PLATE ADJACENT TO THE VENTILATED ATTIC
- RAISED HEEL TRUSS TO ENSURE THAT INSULATION CAN FULLY COVER THE TOP PLATE

R105 Inspections – New in the 2015 IECC

- Construction or work for which a permit is required shall be subject to inspection
- The code official or his/her agent shall inspect....
- Footing and foundation
- Framing and rough-in inspection
- Plumbing rough-in inspection
- Mechanical rough-in inspection
- Final inspection
- Re-inspection



Required Inspections

R105.2.2 Framing and rough-in inspection

- Inspections at framing and rough-in shall be made before application of interior finish and **shall verify** compliance with the code as to types of insulation and corresponding **R-values and their correct location and proper installation**; fenestration properties (*U*-factor and SHGC) and proper installation; and **air leakage controls as required by the code** and approved plans and specifications.

R105.2.4 Mechanical rough-in inspection

- Inspections at mechanical rough-in shall verify compliance as required by the code and *approved* plans and specifications as to installed HVAC equipment type and size, **required controls, system insulation and corresponding R-value, system air leakage control**, programmable thermostats, dampers, **whole-house ventilation**, and minimum fan efficiency.



Focus on House Performance



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Fundamental Questions

Is It There?



Does It Work?



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Fundamental Questions

Is It There?



Does It Work?



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Fundamental Questions

Is It There?



Does It Work?



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Fundamental Questions

Is It There?



Does It Work?



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R105.4 Approved Inspection Agency

- The *code official* is authorized to accept reports of third party inspection agencies not affiliated with the *building* design or construction, provided such agencies are *approved* as to qualifications and reliability relevant to the building components and systems they are inspecting.

- Becomes important for the Energy Rating Path



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Chapter 2: Definitions

Sometimes words are defined within IECC Chapter 2

- **BUILDING THERMAL ENVELOPE**
 - The *basement walls, exterior walls, floors, ceiling, roofs and any other building element assemblies* that enclose *conditioned space* or provide a boundary between *conditioned space* and exempt or unconditioned space.
- **CONTINUOUS AIR BARRIER**
 - A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.
- **ERI REFERENCE DESIGN**
 - A version of the rated design that meets the minimum requirements of the 2006 *International Energy Conservation Code*.

Sometimes words are defined in other codes but used in the IECC

- **JOINT.** The opening in or between adjacent assemblies that is created due to building tolerances, or is designed to allow independent movement of the building in any plane caused by thermal, seismic, wind or any other loading.

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Chapter 3: General

Chapter 3 discusses

- climate zones
- Design conditions
- General info and requirements that apply to materials, systems, and equipment

R302.1 Interior design conditions

- The interior design temperatures used for heating and cooling load calculations **shall be** a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling

R303.1.1 Building thermal envelope insulation

- The insulation installer **shall provide a certification listing the type, manufacture, and R-value of insulation** installed in each element of the building thermal envelope

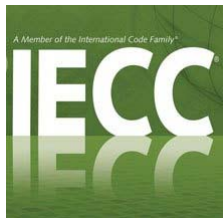
R303.2 Installation

- Materials, systems and equipment **shall be installed in accordance with the manufacturer's instructions** and the International Building Code or International Residential Code, as applicable

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Important things in Chapter 3



R303.1.1 Building thermal envelope insulation.

- An *R*-value **identification mark** shall be applied by the manufacturer **to each piece of *building thermal envelope* insulation**
- **Alternately**, the insulation installers **shall provide a certification** listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*.

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What is the R-Value?



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Fabric for Enclosed Cavity Insulation

A core sample or cookie-cutter test involves taking at least three insulation samples and weighing them.

Imperial Coverage Chart
19.08 ft²/Bag R3.59/Inch 25lb./Bag

Thermal Resistance (R-Value)	Actual Design Thickness (Inches)	Blown-Applied Thickness (Inches)	Weight (lbs/ft ²)	Coverage (ft ² /bag)	Quick Calculator (bags/1000 ft ²)
R10	2.78	3.11	0.32	78.85	12.68
R12	3.33	3.73	0.38	65.71	15.22
R20	5.56	6.22	0.63	39.43	25.36
R28	7.78	8.71	0.89	28.16	35.51
R30	8.34	9.34	0.95	26.28	38.04
R32	8.89	9.96	1.01	24.64	40.58
R34	9.45	10.58	1.08	23.19	43.12
R38	10.56	11.83	1.20	20.75	48.19
R40	11.11	12.45	1.27	19.71	50.73
R44	12.23	13.69	1.39	17.92	55.80
R50	13.89	15.56	1.59	15.77	63.41
R60	16.67	18.67	1.90	13.14	76.09

R-VALUES IN INCHES
(minimum thickness)

R 13 = 5.00" R 38 = 14.50"
R 19 = 7.50" R 44 = 16.50"
R 25 = 10.00" R 49 = 18.25"
R 30 = 11.50" R 60 = 22.00"

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R401.3 Certificate (Mandatory)



- A permanent certificate **shall be completed and posted** on or in the electrical distribution panel by the builder or registered design professional
- The certificate shall list....
 - R-values of insulation
 - R-values of ducts outside conditioned spaces
 - Window U-value and SHGC
 - Results of duct system and building envelope air leakage testing
 - Types and efficiencies of heating, cooling and service water heating equipment.




2018 IECC Certificate

1234 Place to Live, Denver, CO 80221

Building Envelope Insulation		
Ceiling	R-49.0	
Above Grade Walls	R-20.0	
Foundation Walls	R-15.0	
Exposed Floor	R-30.0	
Slab	R-0.0 Edge, R-0.0 Under	
Infiltration	Htg: 3.00 Clg: 3.00 ACH50	
Duct	Uninsulated	
Total Duct Leakage	80.00 CFM @ 25 Pascals	
Window Data	U-Factor	SHGC
Window	0.320	0.320
Mechanical Equipment		
HEAT: Fuel-fired air distribution, Natural gas, 92.1 AFUE.		
COOL: Air conditioner, Electric, 13.0 SEER.		
DHW: Conventional, Natural gas, 0.62 EF, 40.0 Gal.		
Builder or Design Professional		
Signature _____		

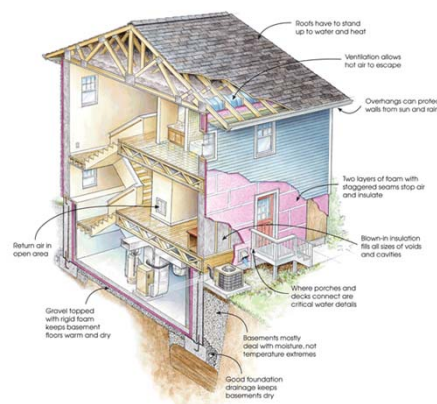
REM/Rate - Residential Energy Analysis and Rating Software v14.6



Chapter 4: Residential Energy Efficiency

Specific and technical requirements for the:

- Building Thermal Envelope
- Mechanical Systems
- Service Hot Water Systems
- Electrical Power and Lighting Systems



Pathways = Flexibility/Options



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Code Compliance Paths



Prescriptive Path



UA Compliance Path

Simulated
Performance PathEnergy Rating Index
Path

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Cost Effective



Value?

- Cost of construction
- Payback
 - Simple payback
 - Investment paid for in a loan
- Cost of ownership
- Ability to build the house that I want to build
- Opportunity cost

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Regardless of the Pathway

International Energy Conservation Code

Mandatory Requirements



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Terminology

- **Mandatory requirements**

- Requirements that must be met by every building unless there is a specific exception in the code

- **Prescriptive requirements**

- Requirements that must be met by every building unless an approved tradeoff is utilized or unless there is a specific exception in the code

- **Performance approach**

- An overall performance requirement for the building that replaces the individual prescriptive requirements for building systems and components

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**Prescriptive****IECC**INTERNATIONAL
ENERGY CONSERVATION
CODE

Prescriptive Path

- Most restrictive path
 - Only option is to do better
- No compliance Tool
- Must declare that this is your method of compliance
- Permitting plan document

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SECTION R402 BUILDING THERMAL ENVELOPE

Prescriptive path ways through code (3 choices)



• R402.1 General (Prescriptive).

- The building thermal envelope shall meet the requirements of Sections R402.1.1 through R402.1.4.
- Sections R402.1.3
 - R-value table specification
- Section R402.1.4
 - U-Value table specification
- Section R402.1.5
 - Total UA Alternative Approach
- R402.1.3 R-value computation
 - Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component R-value
 - The manufacturer's settled R-value shall be used for blown insulation (Attics)
- **Computed R-values shall not include an R-value for other building materials or air films**

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2018 Prescriptive R-value Table Compliance Specification

Declare to the Code official that the pathway for compliance is the prescriptive path

TABLE R402.1.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	Only looking at Cavity or component R-value/U-value										CRAWL SPACE ^b WALL R-VALUE
1											0
2											0
3	0.32	0.55	0.40	38	20 or 13+5 ^b	8/13	19	10/13	10, 2 ft	10/13	
4 except Marine	0.32	0.55	0.40	49	20 or 13+5 ^b	8/13	19	10/13	10, 2 ft	10/13	
5 and Marine 4	0.30	0.55	NR	49	20 or 13+5 ^b	13/17	30 ^f	15/19	10, 2 ft	15/19	
6	0.30	0.55	NR	49	20+5 ^c or 13+10 ^d	15/20	30 ^f	15/19	10, 4 ft	15/19	
7 and 8	0.30	0.55	NR	49	20+5 ^c or 13+10 ^d	19/21	38 ^f	15/19	10, 4 ft	15/19	

NR = Not Required

For SL-1 foot = 304.8 mm

a. R-values are minimums. U-factors and SHGC are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed R-value of the insulation shall be not less than the R-value specified in the table.

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

Exception: In Climate Zones 1 through 3, skylights shall be permitted to be excluded from glazed fenestration SHGC requirements provided that the SHGC for such skylights does not exceed 0.30.

c. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation on the interior of the basement wall.

d. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. Alternatively, compliance with "15/19" shall be R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home.

e. R-5 insulation shall be provided under the full slab area of a heated slab in addition to the required slab edge insulation R-value for slabs, as indicated in the table. The slab edge insulation for heated slabs shall not be required to extend below the slab.

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

g. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.


h. Alternatively, insulation sufficient to fill the framing cavity and providing not less than an R-value of R-19.

i. The first value is cavity insulation, the second value is continuous insulation. Therefore, as an example, "13+5" means R-13 cavity insulation plus R-5 continuous insulation.

j. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

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Floor Systems



Joist cavity area completely filled with insulation (R-30 minimum), Grade 1


Garage

Compression not allowed

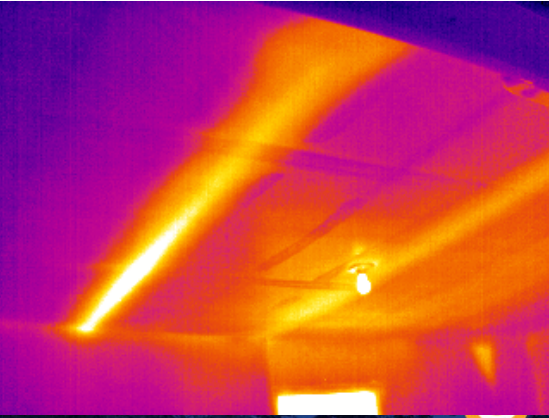
- **Best Practices**
 - Insulation must be in contact with the surface it is intended to insulate
 - Insulation completely fills the cavity
- **R402.2.8 Floors.**
 - Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking
 - R-30 climate zone 5

Ducts in Garage Ceiling

Old Installation methods



What about obstructions in the floor system



energyLogic

Ducts in Garage Ceiling

Code requirements

- Insulation in complete contact with subfloor
- Insulation encapsulates duct
- IECC Table 402.1.2 footnote G
- **Minimum R-19 below duct**



energyLogic



R402.1.4 U-factor Alternative



CLIMATE ZONE	FENESTRATION U-FACTOR	SKYLIGHT U-FACTOR	CEILING U-FACTOR	FRAME WALL U-FACTOR	MASS WALL U-FACTOR ^b	FLOOR U-FACTOR	BASEMENT WALL U-FACTOR	CRAWL SPACE WALL U-FACTOR
1	0.50	0.75	0.035	<u>0.084</u>	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	<u>0.084</u>	0.165	0.064	0.360	0.477
3	0.32	0.55	0.030	<u>0.060</u>	0.098	0.047	0.091 ^c	0.136
4 except Marine 5 and Marine 4	0.32	0.55	0.026	0.060	0.098	0.047	0.059	0.065
5	0.30	0.55	0.026	<u>0.060</u>	0.082	0.033	0.050	0.055
6	0.30	0.55	0.026	<u>0.045</u>	0.060	0.033	0.050	0.055
7 and 8	0.30	0.55	0.026	<u>0.045</u>	0.057	0.028	0.050	0.055

- **An assembly** with a U-factor equal to or less than that specified in Table R402.1.4 shall be permitted as an alternative to the R-value in Table R402.1.2
- Example: Climate zone 5 framed wall
 - U- .060 = R-16.67
 - R-value table requires cavity insulation at R20 or 13+5
 - 1/20 = U.05 Plus sheathing, air film, etc. = U.06

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All other paths us a software



UA Compliance Path



Simulated
Performance Path



Energy Rating Index
Path

energyLogic



What is a Reference Design

- **Reference Design**
 - A standard set of house specifications that generate a specific level of quantifiable energy performance
- The concept Code uses to show compliance with the UA Trade Off (ResCheck), Simulated Performance Path, and ERI Path

The Actual built homes performance will be less than or equal to the performance of the code standard reference design

The Standard reference design for code is the prescriptive path of compliance built in Table 405.5.2 (1)

energyLogic



Twin Houses

2018 IECC reference design house vs.

- Geometric Twin
- 2015 IECC prescriptive envelope U-values in (Table 402.1.4)



Builder's desired house

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



If the Builder's house has the same or lower area weighted U-values then it meets the intent of code

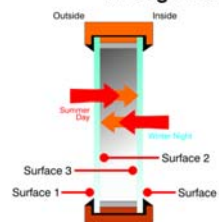
energyLogic



R402.1.5 Total UA alternative

- A method for performing conductive energy trade offs
 - Trading off the R-values and U-values in the thermal envelope
 - Mathematically making the R-value and U-value paths


Conduction = Heat Flow through Materials



Copyright 2017 Digital Data Windows Works. All rights reserved.

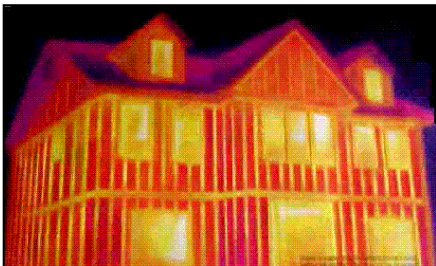

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 **PREscriptive**

R402.1.5 Total UA alternative

- If the total building thermal envelope UA (sum of U-factor times assembly area) is less than or equal to the total UA resulting from using the U-factors in Table R402.1.4 (multiplied by the same assembly area as in the proposed building), the building shall be considered in compliance with Table R402.1.1.
- The UA calculation shall include the thermal bridging effects of framing materials.

Example

 **REScheck**™

Untitled.rck - REScheck 3.5 Release 1b Code: 2018 IECC

File Edit View Options Code Tools Help

Project Envelope Mechanical

Ceiling Skylight Wall Window Door Basement Floor Crawl Wall

	Component	Assembly	Gross Area		Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	UA
Building								
1	Ceiling 1	Flat Ceiling or Scissor Truss	400	ft2	40	0.0	0.035	14
2	Wall 1	Wood Frame, 16" o.c.	640	ft2	20	0.0	0.082	46
3	Window 1	Vinyl Frame Double Pane	64	ft2			.30	26
4	Door 1	Solid	20	ft2			0.6	12
5	Floor 1	All-Wood Joist/Truss Ove...	400	ft2	30	0.0	0.047	19

Compliance Max. UA **134** Your UA **128** **4.5** % Better Than Code

Enter the R-value of the insulating sheathing.

energyLogic



 **REScheck Software Version 4.6.3**
Compliance Certificate

Project

Energy Code: **Code: 2018 IECC**
 Location: **2775 E. 10th Ave., Aurora, CO 80014**
 Construction Type: **Single-family**
 Project Type: **New Construction**
 Conditioned Floor Area: **3,405 ft²**
 Glazing Area: **13%**
 Climate Zone: **5 (6443 HDD)**
 Permit Number:

Construction Site: **Beautiful Home Plan**
 Anytown, CO

Owner/Agent: **ABC Construction Co**

Designer/Contractor: **Scott Home Inspection, LLC**
 Berthoud, CO 80513

Compliance: Passes using UA trade-off

Compliance: **3.2% Better Than Code** Maximum UA: **375** Your UA: **363**

The % Better or Worse Than Code Index reflects how close to compliance the house is based on code trade-off rules. It DOES NOT provide an estimate of energy use or cost relative to a minimum-code home.

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	U-Factor	UA
Ceiling 1: Flat Ceiling or Scissor Truss	1,400	13.0	36.0	0.020	28
Wall 1 Front: Wood Frame, 16" o.c.	700	21.0	0.0	0.057	32
Window 1: VinylFiberglass Frame Double Pane with Low-E	105			0.340	36
Window 2: VinylFiberglass Frame Double Pane with Low-E	6			0.310	2
Door 1: Solid	20			0.200	4
Wall 2 Rear: Wood Frame, 16" o.c.	700	21.0	0.0	0.057	32
Window 3: VinylFiberglass Frame Double Pane with Low-E	101			0.340	34
Door 2: Glass	40			0.330	13
Wall 3 Left: Wood Frame, 16" o.c.	730	21.0	0.0	0.057	40
Window 4: VinylFiberglass Frame Double Pane with Low-E	30			0.340	10
Wall 4 Right: Wood Frame, 16" o.c.	730	21.0	0.0	0.057	39
Window 5: VinylFiberglass Frame Double Pane with Low-E	29			0.340	10
Door 1: Solid	20			0.200	4
Basement Wall 1: Solid Concrete or Masonry	1,200	19.0	0.0	0.045	53

energyLogic 

2018 IECC Building UA Compliance

Property: **Best Builder In America Homes**
 8925 Place to Live
 Denver, CO 80238

Organization: **EnergyLogic**
 720-638-0677
 Robby Shwarz

Inspection Status: **Results are projected**

Builder: **Best Builder In America H**

8925 Best Place To Live
 Robby's Test play house

Building UA

Elements	IECC Reference	As Designed
Ceilings	90.0	91.1
Above-Grade Walls	143.4	127.2
Windows, Doors and Skylights	160.0	163.7
Slab Floor	28.1	28.1
Framed Floors	11.6	9.3
Basement Walls	58.4	63.7
Rim Joists	12.7	11.0
Overall UA (Design must be equal or lower):	453.8	444.6


Mandatory Requirements

Requirement	Compliance
402.1.6 Total UA alternative for insulation and fenestration	✓
402.4.1.2 Air Leakage Testing	✓
402.5 Area-weighted average fenestration SHGC	✓
402.5 Area-weighted average fenestration U-Factor	✓
404 Lighting Equipment Efficiency	✓
403.3.3 Duct testing	✓
403.5.3 Hot water pipe insulation	✓

Mandatory Checklist

Design exceeds requirements for IECC 2015 Prescriptive compliance by 2%.

Name: Robby Shwarz Signature: _____
 Organization: EnergyLogic Date: May 25, 2017

energyLogic 

Envelope Sample Inspection Checklist

2009 IECC	Foundation Inspection	Plans Verified Value	Field Verified Value	Complies?	Comments/Assumptions
402.1.1 [FO1] ¹	Slab edge insulation R-value.	R-____ <input type="checkbox"/> Unheated <input type="checkbox"/> Heated	R-____ <input type="checkbox"/> Unheated <input type="checkbox"/> Heated	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not Comply <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	See the Envelope Assemblies table for values.
303.2 402.2.8 [FO2] ¹	Slab edge insulation installed per manufacturer's instructions.			<input type="checkbox"/> Complies <input type="checkbox"/> Does Not Comply <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	Requirement will be met.
402.1.1 [FO3] ¹	Slab edge insulation depth/length.	____ ft	____ ft	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not Comply <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	See the Envelope Assemblies table for values.
402.1.1 [FO4] ¹	Conditioned basement wall insulation R-value. Where internal insulation is used, verification may need to occur during Insulation Inspection. Not required in warm-humid locations in Climate Zone 3.	R-____	R-____	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not Comply <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	See the Envelope Assemblies table for values.
303.2 [FO5] ¹	Conditioned basement wall insulation installed per manufacturer's instructions.			<input type="checkbox"/> Complies <input type="checkbox"/> Does Not Comply <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	Requirement will be met.
402.2.7 [FO6] ¹	Conditioned basement wall insulation depth of burial or distance from top of wall.	____ ft	____ ft	<input type="checkbox"/> Complies <input type="checkbox"/> Does Not Comply <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	See the Envelope Assemblies table for values.
303.2.1 [FO11] ²	A protective covering is installed to protect exposed exterior insulation and extends a minimum of 6 in. below grade.			<input type="checkbox"/> Complies <input type="checkbox"/> Does Not Comply <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	Requirement will be met.
403.8 [FO12] ²	Snow- and ice-melting system controls installed.			<input type="checkbox"/> Complies <input type="checkbox"/> Does Not Comply <input type="checkbox"/> Not Observable <input type="checkbox"/> Not Applicable	

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Code Compliance Paths



Prescriptive Path



UA Compliance Path

Simulated
Performance PathEnergy Rating Index
Path

energyLogic



Simulated performance alternative 405 Performance

- This section establishes criteria for compliance using simulated energy performance analysis.
- Such analysis shall include
 - Heating
 - Cooling,
 - Service water heating energy only.
- Compliance with this Section requires that the **(Mandatory)** items still be met.



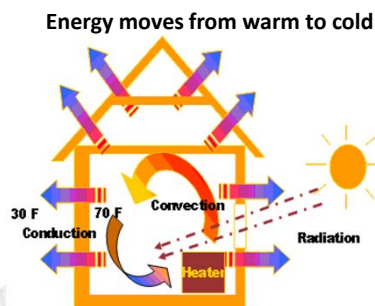
Mechanical equipment tradeoff removed

energyLogic



R405 Performance-based compliance

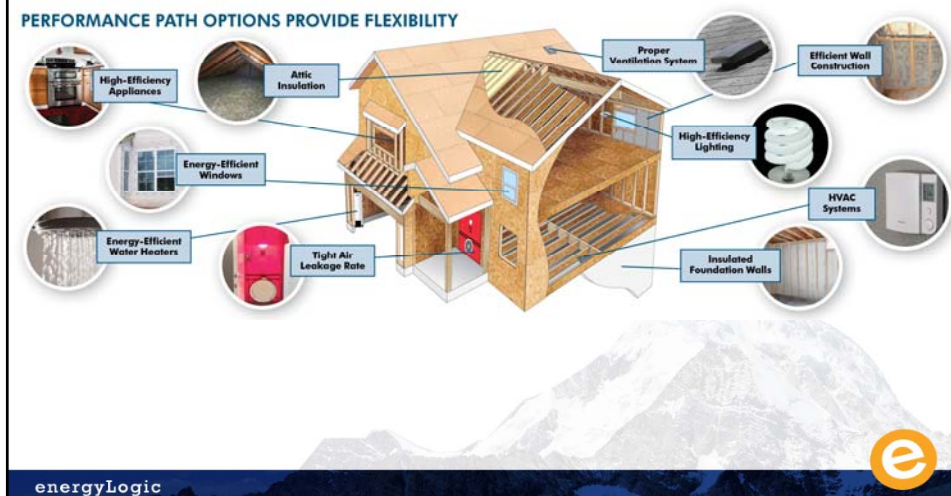
- Energy Analysis
 - A method for performing whole house performance energy trade offs
 - **Conduction** - Trading off R-values and U-values
 - **Convection** – Energy moving with air infiltration and exfiltration
 - **Radiation** – Trade offs created by energy moving from areas of high concentrations to low concentration through open space.



energyLogic



Building Science built into the code



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

2018 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*

- Geometric Twin
- Envelope R/U-values based on Builder's Specification



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Energy Costs?



- **405.3 Performance-based compliance.** Compliance based on simulated energy performance requires that a proposed residence (proposed design) be shown to have an **annual energy cost** that is less than or equal to the annual energy cost of the standard reference design.

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SECTION R405

SIMULATED PERFORMANCE ALTERNATIVE (PERFORMANCE)



- **R405.3 Performance-based compliance.**
 - Energy prices shall be taken from a source *approved by the code official*, such as the Department of Energy, Energy Information Administration's *State Energy Price and Expenditure Report*
- **R405.4.2 Compliance report**
 - Batch sampling of *buildings* to determine energy code compliance shall only be allowed for stacked multiple-family units

energyLogic



IECC 2015 Performance Compliance


Property
Ekotrope
123 Fake St
Anytown, CO 80840

Confirmed Rating
Confirmed Rating

Organization
Ekotrope Rating Co.
Test Rater

Builder
Ekotrope

HERS Rating Information
Rater ID (RTIN): 5459458
HERS Status: Confirmed



	Annual Energy Cost	IECC 2015 Performance	As Designed
Heating		\$2,412	\$2,451
Cooling		\$257	\$163
Water Heating		\$277	\$277
SubTotal - Used to determine compliance		\$2,946	\$2,891
Lights & Appliances		\$1,982	\$1,944
Onsite generation		\$0	\$0
Total		\$4,929	\$4,835

2013
Performance-based compliance

✓

2014.1.3
Air Leakage Testing

✓

2015
Area-weighted average fenestration SHGC

✓

2015
Area-weighted average fenestration U-Factor

✓

2014
Lighting Equipment Efficiency

✓

Mandatory Checklist

✓

Design exceeds requirements for IECC 2015 Performance compliance by 1.9%.

Name: _____ Test Rater

Organization: _____ Ekotrope Rating Co.


Signature: _____

Date: _____ Jan 05, 2017

energyLogi

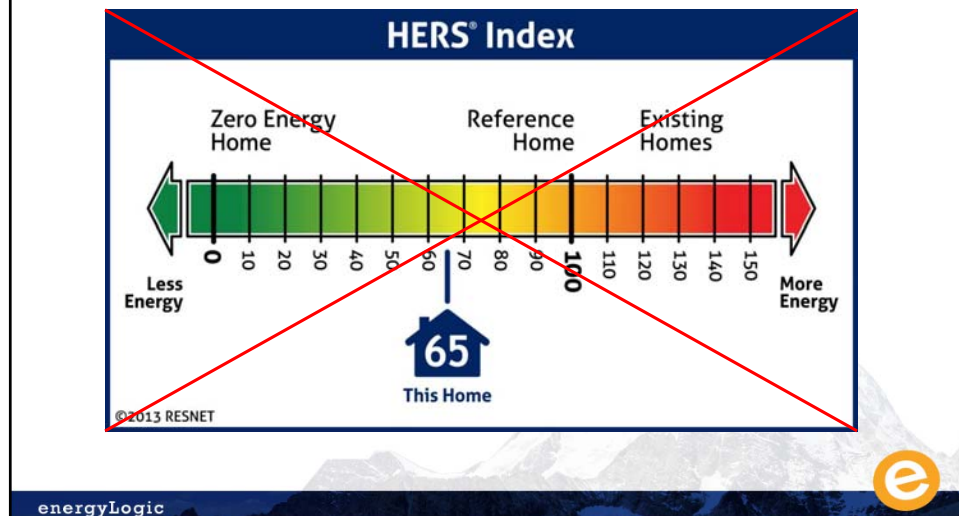
Ekotrope HERS Rating Tool - Version 2.0.0 1592

IECC 2015 Performance compliance results calculated using Ekotrope's energy algorithm, which is a RESNET Accredited IECC Rating Tool.



By Product

Not a code compliance document



Submittal Documents

- Need to release building permit
- Document the predicted performance of the proposed design



energyLogic



2018 IECC Energy Cost Compliance

Property
2015 ERI Base House
1234 Place to Live
Denver, CO 80221

Weather: Denver, CO
2015 ERI Compliance
2015 Prescriptive Path HERS

Organization
EnergyLogic, Inc.
(970) 556-0839
Robby Schwarz

Builder

Projected
2/10/2015
Rating No: 34332
Rater ID: 1215211



Annual Energy Cost

	2015 IECC	As Designed
Heating	604	616
Cooling	220	144
Water Heating	186	186
SubTotal - Used to Determine Compliance	1008	945
Lights & Appliances	822	811
Photovoltaics	-0	-0
Service Charge	0	0
Total	1830	1756

Mandatory Requirements

Annual Energy Cost Check	PASSES
Duct Insulation R-Value Check (per Section 405.2)	PASSES
Window U-Value and SHGC Check (per Section 402.5)	PASSES
Home Infiltration (Section 402.4.1.2)	PASSES
Duct Leakage (Section 403.3.3)	PASSES
Mechanical Ventilation (Section 403.6)	PASSES
Mechanical Ventilation Fan Efficacy (Section 403.6.1)	PASSES
Mandatory Requirements Check Box (IECC 15)	PASSES

This home MEETS the annual energy cost requirements of Section 405 of the 2015 International Energy Conservation Code based on a climate zone of 9B. In fact, this home surpasses the requirements by 6.3%.

Name | Robby Schwarz
Organization | EnergyLogic, Inc.

Signature |
Date | 14 February 2015

In accordance with IECC, building inputs, such as setpoints, infiltration rates, and window shading may have been changed prior to calculating annual energy cost. Furthermore, the standard reference design HVAC system efficiencies are set equal to those in the design home as specified in the 2015 IECC. These standards are subject to change, and software updates should be obtained periodically to ensure the compliance calculations reflect current federal minimum standards.

energyLogic



Energy Code Inspection Checklist

Property
Best Builder In America Homes
8925 Place to live
Denver, CO 80238

Builder
8925 Best Place To Live
Robby's Test play house

Organization
EnergyLogic
720-638-0677
Robby Schwarz

Builder
Best Builder In America H

Inspection Status
Results are projected

energyLogic

General Building Information

Conditioned Area (sq ft)	3,560
Conditioned Volume (cubic ft)	34,393
Insulated Shell Area (sq ft)	7,382.36

The building energy model in Ekotrope reflects the building assemblies and energy features listed below. Sometimes energy features will change in the field from what has been modeled. The inspection process should identify any changes and ensure that the home continues to meet the applicable energy code.

Roof

☐ Name: attic (1,372 s.f.)
R-25 continuous insulation, R-13 cavity insulation
Insulation Grade: I

☐ Name: attic eve (152 s.f.)
R-17 continuous insulation, R-13 cavity insulation
Insulation Grade: I

Above Grade Wall

☐ Name: Front (400.3 s.f.)
R-0 continuous insulation, R-23 cavity insulation
Insulation Grade: I


☐ Name: Left (702.7 s.f.)
R-0 continuous insulation, R-23 cavity insulation
Insulation Grade: I

☐ Name: Back (654.1 s.f.)
R-4 continuous insulation, R-23 cavity insulation
Insulation Grade: I

☐ Name: Right (575.7 s.f.)
R-0 continuous insulation, R-23 cavity insulation
Insulation Grade: I

☐ Name: garage (324 s.f.)
R-0 continuous insulation, R-23 cavity insulation
Insulation Grade: I

1



energyLogic

Compliance Documents Needed to release the certificate of occupancy

CITY AND COUNTY OF DENVER

Certificate of Occupancy

issued by the City and County of Denver Development Services on this date, 04/19/2017
building or portion located at:

3451 Larimer St

as that as of this date, this building or portion described below has been inspected
Denver Building Code and other ordinances of the City and County of Denver reg
and use of this building for:

USE: B/TATTOO SHOP

DESCRIPTION: 3451 Larimer St - Change of Occupancy - New tenant no work - Denver City T

SECTION: V-B

ISSUED: 2015 IBC 2015 DEC



energyLogic

IECC 2015 Performance Compliance


Property
Ekotrope
123 Fake St
Anytown, CO 80840

Confirmed Rating
Confirmed Rating

Organization
Ekotrope Rating Co.
Test Rater

Builder
Ekotrope

HERS Rating Information
Rater ID (RTIN): 5458458
HERS Status: Confirmed



Annual Energy Cost		IECC 2015 Performance	As Designed
Design			
Heating		\$2,412	\$2,451
Cooling		\$257	\$163
Water Heating		\$277	\$277
Sub Total - Used to determine compliance		\$2,946	\$2,891
Lights & Appliances		\$1,982	\$1,944
Onsite generation		\$0	\$0
Total		\$4,929	\$4,835

205.3
Performance-based compliance

✓

202.4.1.2
Air Leakage Testing

✓

205.5
Area-weighted average fenestration SHGC

✓

205.5
Area-weighted average fenestration U-Factor

✓

204
Lighting Equipment Efficiency

✓

Mandatory Checklist

✓


Design exceeds requirements for IECC 2015 Performance compliance by 1.9%.

Name: _____ Test Rater

Organization: _____ Ekotrope Rating Co.


Signature: _____

Date: _____ Jan 05, 2017



Ekotrope HERS Rating Tool - Version 2.0.0.1590

IECC 2015 Performance compliance results calculated using Ekotrope's energy algorithm, which is a RESNET Accredited IECC Rating Tool.



123 Fake St

Ekotrope

THIS HOME IS CERTIFIED TO MEET THE 2015 INTERNATIONAL ENERGY CONSERVATION CODE

Building Features

Ceiling Flat R-60	Duct Supply R-8.0, Return R-8.0
Above Grade Walls R-21	Duct Leakage to Outside 0.0 CFM @ 25 Pa
Foundation Walls R-11	Total Duct Leakage 0.0 CFM @ 25 Pa
Framed Floor R-0	Heating Furnace • Natural Gas • 95 AFUE
Slab R-10.0 Perimeter, R-0.0 Under	Cooling Air Conditioner • Electric • 16 SEER
Infiltration 1660 CFM50	Water Heating Water Heater • Natural Gas • 0.67 Energy Factor
Window U-Value: 0.31 SHGC: 0.25	

The organization below certifies that the proposed building design described herein is constant with the building plans, specifications, and other calculations submitted with the permit application. The proposed building has been designed to meet the 2015 IECC requirements in compliance with Chapter 4 based on Climate Zone 5 and with all mandatory requirements.

Name: _____ Test Rater

Organization: _____ Ekotrope Rating Co.

Signature: _____

Date: _____ Jan 05, 2017

Ekotrope HERS Rating Tool - Version 2.0.0.1590

No version of this software has been reviewed or approved by ICC or its affiliates.

The 2015 International Energy Conservation Code is a registered trademark of the International Code Council, Inc. (ICC).


This software has been accredited by RESNET to demonstrate IECC Performance Path Compliance.

2018 IECC Certificate

1234 Place to Live, Denver, CO 80221

Building Envelope Insulation		
Ceiling	R-49.0	
Above Grade Walls	R-20.0	
Foundation Walls	R-15.0	
Exposed Floor	R-30.0	
Slab	R-0.0 Edge, R-0.0 Under	
Infiltration	Htg: 3.00 Clg: 3.00 ACH50	
Duct	Uninsulated	
Total Duct Leakage	80.00 CFM @ 25 Pascals	
Window Data	U-Factor	SHGC
Window	0.320	0.320
Mechanical Equipment		
HEAT: Fuel-fired air distribution, Natural gas, 92.1 AFUE.		
COOL: Air conditioner, Electric, 13.0 SEER.		
DHW: Conventional, Natural gas, 0.62 EF, 40.0 Gal.		
Builder or Design Professional		
Signature _____		

REM/Rate - Residential Energy Analysis and Rating Software v14.6



Code Compliance Paths





Prescriptive Path



UA Compliance Path



**Simulated
Performance Path**



**Energy Rating Index
Path**



Section R406 of the 2015 and 2018 IECC Energy Rating Index Compliance Alternative

- What is an Energy Rating Index



energyLogic



Section R406 of the 2018 IECC Energy Rating Index Compliance Alternative

Home Energy Rating Certificate Confirmed Report

Rating Date:
Registry ID: 631462669
Rating Number: 631462669

ekotrope



HERS® Index Score:

47 Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.hersindex.com

Annual Savings

\$5,912
*Relative to an average U.S. home

Home:

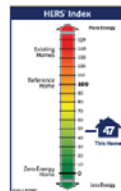
123 Fake St. Anytown, CO

Builder:

Ekotrope

Your Home's Estimated Energy Use:

	Use (MBtu)	Annual Cost
Heating	77.0	\$2,182
Cooling	0.9	\$83
Hot Water	17.1	\$240
Lights/Appliances	36.0	\$1,944
Service Charges		\$0
Generation (e.g., Solar)	23.1	-\$2,689
Total:	131.1	\$1,730



Home Feature Summary:

Home Type: Single family detached
Conditioned Floor Area: 4,500 sq. ft.
Number of Bedrooms: 4
Primary Heating System: Furnace • Natural Gas • 95 AFUE
Primary Cooling System: Air Conditioner • Electric • 16 SEER
Primary Water Heating: Water Heater • Natural Gas • 0.67 Energy Factor
House Tightness: 1600 CFM50
Duct Leakage to Outside: 0 CFM25
Above Grade Walls: R-21
Ceiling: R-50
Window Type: U-Value: 0.310, SHGC: 0.250
Foundation Walls: R-11

This home meets or exceeds the criteria of the following:

Energy Star v3
Energy Star v3.1
2006 International Energy Conservation Code
2009 International Energy Conservation Code
2012 International Energy Conservation Code
2015 International Energy Conservation Code

Rating Completed by:

Energy Rater: Test Rater
RESNET ID: 6489458
Rating Company: Ekotrope Rating Co.

Rating Provider: Ekotrope Provider

Test Rater, Certified Energy Rater

ekotrope

Ekotrope HERS Rating Tool - Version 2.0.0.1590
The Home Energy Rating Standard Disclosure for this house is available from the rating provider.

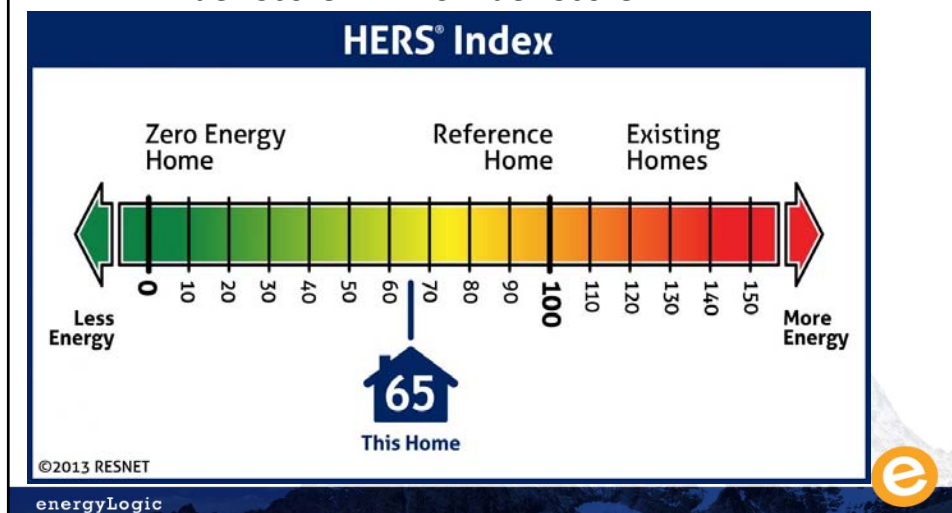
energyLogic



Quantifying Energy Use

ERI vs. HERS

- ERI Index Score = HERS Index Score



Code Book misprint and the Errata

er·ra·tum

i' rätəm, -' rā-, -' rat-/ *noun*

plural noun: **errata**

An error in printing or writing.

A list of corrected errors appended to a book or published in a subsequent issue of a journal.

- **R406.2 Mandatory requirements.** Compliance with this section requires that the ~~mandatory~~ provisions identified in Sections ~~R401.2~~ R401 through R404 labeled as "mandatory" and Section R403.5.3 be met. The building thermal envelope shall be greater than or equal to levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.2 or 402.1.4 of the 2009 *International Energy Conservation Code*.

energyLogic

Mandatory sections of the 2018 IECC

- R401.1 Mandatory Requirements
 - Section R402.4 Air Leakage
 - R402.4.1.2 Testing
 - Air leakage rate not exceeding 5 air changes per hour in Climate Zones 1 and 2, and 3 air changes per hour in Climate Zones 3 through 8
 - Table R402.4.1.1 Air barriers and Insulation
 - Section R403 Systems
 - Section R404 Electrical Power and Lighting Systems
 - Prescriptive requirements in R403.5.3
 - Hot water pipe insulation



energyLogic

R406.2 Mandatory Requirements

- The building thermal envelope shall be **greater than or equal** to levels of efficiency and Solar Heat Gain Coefficient in Table 402.1.1 or 402.1.3 of the **2009 International Energy Conservation Code**.

2018 IECC

- If Solar is installed on a home using the ERI path, builders **must** also meet the minimum prescriptive envelope efficiency measures in the 2015 IECC
- If there is no solar on the home then the builders **must** also meet the minimum prescriptive envelope efficiency measures in the 2009 IECC



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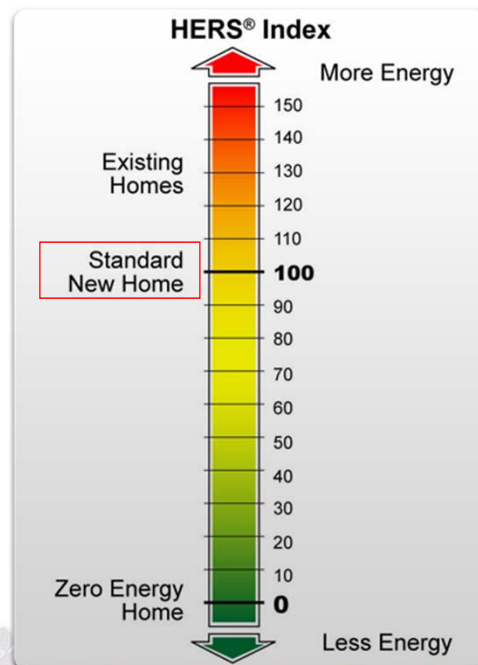
2009 IECC vs. 2015 IECC Prescriptive Table

Climate Zone	Window U-Factor	Window SHGC	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
1	1.2 NR	0.30 0.25	R-30	R-13	R-3/4	R-13	0	0	0
2	0.65 0.40	0.30 0.25	R-30 38	R-13	R-4/6	R-13	0	0	0
3	0.35 0.35	0.30 0.25	R-30 38	R-13 20 or 13+5	R-5/8 8/13	R-19	R-5/13	0	R-5/13
4 except Marine	0.35 0.35	NR 0.40	R-38 49	R-13 20 or 13+5	R-5/10 8/13	R-19	R-10/13	R-10, 2ft	R-10/13
5 and Marine 4	0.35 0.32	NR	R-38 49	R-20 or 13+5	R-13/17	R-30	R-10/13 15/19	R-10, 2ft	R-10/13 15/19
Climate Zone 6	0.35 0.32	NR	R-49	R-20 or 13+5 20+5 or 13+10	R-15/20	R-30	R-15/19	R-10, 4ft	R-10/13 15/19
Climate Zone 7 & 8	0.35 0.32	NR	R-49	R-21 20+5 or 13+10	R-19/21	R-38	R-15/19	R-10, 4ft	R-10/13 15/19

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Why create a backstop

- 100 meets the minimum requirements of the 2006 International Energy Conservation Code prescriptive requirements



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Why create a backstop?

2006 IECC compliant

- 2 story
- 2800 Square Feet
- Single Family Detached
- Conditioned basement
- HERS Index
 - HERS 98

House Specs

- Foundation R-10
- Slab R-0
- Floor over garage R-30 **Grade 3**
- Rim R-19 **Grade 3**
- Walls blown R-19 **Grade 3**
- Windows U-.35/SHGC -.35
- Doors R-5/ R-2.2
- Attic R-38 flat R-30 edge
- Furnace 80 AFUE w/ 200 CFM LTO & 20% return in attic R-6 /20% supply in garage ceiling
- Water Heater .54 EF
- AC 12 Seer
- 7 ACH50 & Exhaust Ventilation
- Default appliances 10% CFL

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Why create a backstop?

2009 IECC compliant

- 2 story
- 2800 Square Feet
- Single Family Detached
- Conditioned basement
- HERS Index
 - HERS 95
 - 6.4K PV system = 55

House Specs

- Foundation R-10
- Slab R-0
- Floor over garage R-30 Grade 1
- Rim R-19 Grade 1
- Walls blown R-19 Grade 1
- Windows U-.35/SHGC -.35
- Doors R-5/ R-2.2
- Attic R-38 flat R-30 edge
- Furnace 80 AFUE w/ 200 CFM LTO & 20% return in attic R-6 /20% supply in garage ceiling
- Water Heater .54 EF
- AC 12 Seer
- 7 ACH50 & Exhaust Ventilation
- Default appliances 10% CFL

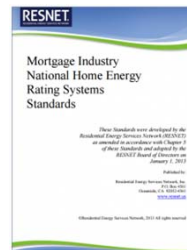
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R406.3.1 ERI reference design

2015 IECC

- The **ERI reference design** shall be configured such that it meets the minimum requirements of the 2006 *International Energy Conservation Code* prescriptive requirement



2018 IECC

- The Energy Rating Index will be developed in accordance with ANSI/RESNET/ICC 301-2014
- The proposed residential building shall be shown to have an annual total normalized Modified Loads that are less than or equal to the annual total Loads of the **ERI reference design**



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Twin Houses

ERI reference design house

- Geometric Twin
- 2006 IECC prescriptive requirements



vs.

Builder's desired house

- Geometric Twin
- Mandatory 2009 IECC Envelope R-Values
- 2015 IECC Mandatory Requirements



The Builder's house must have the Energy Rating Index Required by code, or lower, to meet the intent of code

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Table R406.4 Maximum Energy Rating Index

Climate Zone	2015 IECC Energy Rating Index	Climate Zone	2018 IECC Energy Rating Index
1	52	1	57
2	52	2	57
3	51	3	57
4	54	4	62
5	55	5	61
6	54	6	61
7	53	7	58
8	53	8	58

- Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to the appropriate value listed in Table R406.3, when compared to the *ERI reference design*

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Features that Impact the ERI (Lower the score)

- Mechanical equipment
 - High efficiency furnace
 - High efficiency AC
 - High efficiency water heater
- More R-value than required by the 2009 IECC
- House orientation with the ERI
- House tightness below 3 ACH50
- Duct leakage to the outside
- Duct location
- Whole house fan
- CFL or LED Lighting above 75%
- High efficiency appliances
- Solar



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ERI Calculation includes

- Internal gains
- Internal mass
- Structural mass
- Heating and cooling systems
 - Equipment efficiencies and sizing
 - Air-and ground-source heat pumps
 - Solid fuel combustion
- Service water heating systems
- Thermal distribution systems
- Thermostat
- Lighting, appliance and miscellaneous loads



States that Allow the ERI Compliance Option in the International Energy Conservation Code® (IECC®)



ERI Compliance Option in the IECC (Section R 406)

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R406.6 Documentation

- Documentation of the software used to determine the ERI and the parameters for the residential building in accordance with Sections R406.6.1 through R406.6.3
 - Compliance software tools
 - Compliance report
 - Additional Documentation



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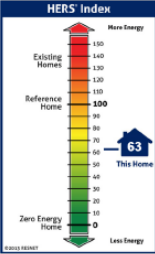




Property
Builder: Best Builder In America Homes
Address: 8625 Place to live, Denver, CO

Organization
Company: EnergyLogic
Phone: 720-838-0677
Rater: Robby Shwarz

Energy Rating Index Information
Projected Rating
Rating No:
Rater ID (RTIN): 9124083
Date Rated: 6/29/2016



HERS Index Scale: 0 (Zero Energy Home) to 150 (More Energy). This Home is at 63.

Estimated Annual Energy Consumption*		
	Rated Home Calculated Energy Use (MBtu)	Rated Home Cost (\$/yr)
Heating	50.7	\$626
Cooling	2.5	\$88
Water Heating	18.9	\$172
Lights & Appliances	32.1	\$1,050
Photovoltaics	0.0	\$0
Total	113.1	\$1,936

*Based on standard operating conditions

ERI with PV: 63
ERI without PV: 63

Annual Estimates	
Electric (kWh): 10,063.9	CO2 Emissions (Tons): 14.3
Natural Gas (Therms): 787.9	Energy Savings (\$)**: N/A

**Based on the 2015 IECC R-406 Reference design home


Maximum Energy Rating Index: 55 This Home's Energy Rating Index: 63 **FAIL**


This home DOES NOT MEET the Energy Rating Index Score requirement of 2015 IECC R-406 based on Climate Zone 5. In addition to the Energy Rating Index other mandatory measures must be met. (See Mandatory Requirements on second page.)

Name: Robby Shwarz Signature: _____
Organization: EnergyLogic Date: Oct 12, 2017


Rating Provider Data and Seal

Company: EnergyLogic
Address: PO Box N Berthoud, CO 80513
Phone #: (970) 556-0839
Fax #:





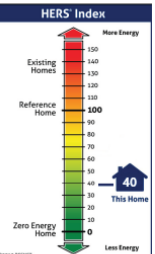
To determine if a provider is properly accredited go to: www.resnet.us/professional/programs/search_directory



Property
Builder: Ekotrope
Address: 123 Fake St, Anytown, CO

Organization
Company: Ekotrope Rating Co.
Phone:
Rater: Test Rater

Energy Rating Index Information
RESNET Confirmed Rating
Rating No: 631462869
Rater ID (RTIN): 5456458
Date Rated:



HERS Index Scale: 0 (Zero Energy Home) to 150 (More Energy). This Home is at 40.

Estimated Annual Energy Consumption*		
	Rated Home Calculated Energy Use (MBtu)	Rated Home Cost (\$/yr)
Heating	77.1	\$1,182
Cooling	0.9	\$53
Water Heating	17.1	\$240
Lights & Appliances	38.0	\$1,944
Photovoltaics	-23.1	-\$1,351
Total	131.2	\$731

*Based on standard operating conditions

ERI with PV: 40
ERI without PV: 58

Annual Estimates	
Electric (kWh): 10,525.3	CO2 Emissions (Tons): 15.7
Natural Gas (Therms): 952.3	Energy Savings (\$)**: \$280

**Based on the 2015 IECC R-406 Reference design home


Maximum Energy Rating Index: 55 This Home's Energy Rating Index: 40 **PASS**


This home MEETS the Energy Rating Index Score requirement of 2015 IECC R-406 based on Climate Zone 5. In addition to the Energy Rating Index other mandatory measures must be met. (See Mandatory Requirements on second page.)

Name: Test Rater Signature: _____
Organization: Ekotrope Rating Co. Date: May 10, 2017

Rating Provider Data and Seal

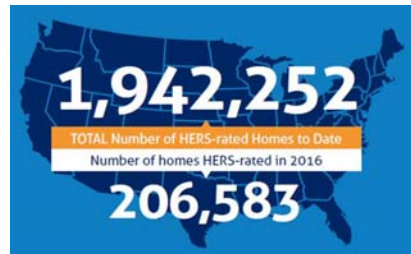
Company: Ekotrope Provider
Address:
Phone #:
Fax #:





To determine if a provider is properly accredited go to: www.resnet.us/professional/programs/search_directory

Will the ERI path be used?



- In 2015
 - 190,180 homes were rated
 - Average HERS Index 62
- In 2016
 - 206,583 homes were rated
 - Average HERS Index 61

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End Goal



Prescriptive Path

UA Compliance Path

Performance Path

Energy Rating Index
Path

Base Case Compliance

2018 Compliance Reality

- 2 story
- 2800 Square Feet
- Single Family Detached
- Conditioned basement
- UA Alternative
 - Pass by 6.3%
- Simulate Performance
 - Pass by 1.8%
- Corresponding HERS Index
 - HERS 72

House Specs

- Foundation R-15
- Slab R-0
- Floor over garage R-30
- Rim R-19
- Walls blown R-20
- Windows U-32/SHGC.32
- Doors R-5/ R-2.2
- Attic R-49 flat R-38 edge
- Furnace 80 AFUE w/ 150 CFM LTO & 10% in attic R-8
- Water Heater 62 EF
- AC 13 Seer
- 3 ACH50 & Exhaust Ventilation
- Default appliances 75% CFL

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Typical Code House in Colorado

2018 Compliance Reality

- 2 story
- 2800 Square Feet
- Single Family Detached
- Conditioned basement
- UA Alternative
 - Pass by 3%
- Simulate Performance
 - Pass by 6.9%
- Corresponding HERS Index
 - HERS 61

House Specs

- Foundation R-11
- Slab R-0
- Floor over garage R-50
- Rim R-19
- Walls blown R-23
- Windows U-34/SHGC.32
- Doors R-5/ R-2.2
- Attic R-38 flat R-30 edge
- Furnace 92.5 AFUE w/ 50 CFM LTO & 10% in attic R-8
- Water Heater 62 EF
- AC 13 Seer
- 2.5 ACH50 & Exhaust Ventilation
- Default appliances 100% CFL

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Which Pathway to use?

Home Energy Rating Certificate Confirmed Report

Rating Date:
Registry ID: 631462669
Rating Number: 631462669



HERS® Index Score:

47

Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.hersindex.com

Annual Savings

\$5,912

*Relative to an average U.S. home

Home:

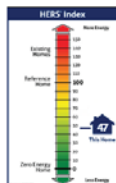
123 Fake St. Anytown, CO

Builder:

Ekotrope

Your Home's Estimated Energy Use:

	Use (MBtu)	Annual Cost
Heating	77.0	\$2,182
Cooling	0.9	\$53
Hot Water	17.1	\$240
Lights/Appliances	36.0	\$1,944
Service Charges		\$0
Generation (e.g. Solar)	23.1	-\$2,689
Total:	181.1	\$1,730



Home Feature Summary:

Home Type:	Single family detached
Conditioned Floor Area:	4,300 sq. ft.
Number of Bedrooms:	4
Primary Heating System:	Furnace - Natural Gas - 95 AFUE
Primary Cooling System:	Air Conditioner - Electric - 15 SEER
Primary Water Heating:	Water Heater - Natural Gas - 0.67 Energy Factor
House Tightness:	1560 CFM50
Duct Leakage to Outside:	9 CFM25
Above Grade Walls:	R-21
Ceiling:	R-50
Window Type:	U-Value 0.310, SHGC 0.250
Foundation Walls:	R-11

This home meets or exceeds the criteria of the following:

Energy Star v3
Energy Star v3.1
2006 International Energy Conservation Code
2009 International Energy Conservation Code
2012 International Energy Conservation Code
2015 International Energy Conservation Code

Rating Completed by:

Energy Rates/Test Rater

RESNET ID: 9459458

Rating Company: Ekotrope Rating Co.

Rating Provider: Ekotrope Provider



Test Rater, Certified Energy Rater



Ekotrope HERS Rating Tool - Version 2.0.0.1190

The Home Energy Rating Standard Disclosure for this house is available from this rating provider.

Section R406 Simulated Performance Path HERS Index is a **by product**

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Four Steps of IECC Performance Compliance Simulated Performance Path or Energy Rating Index

Step 1

From Plan Analysis:

- Demonstrates that the proposed design will comply with the IECC.
- Determine the most cost effective way to comply with the IECC.
- Develop required permitting submittal documents.
- Assistance with other required documents such as air sealing details.

Step 2

Rough Inspection:

- Perform IECC required rough inspections for compliance, quality assurance, and builder risk.
- Inspections allow 3rd Party to generate final documentation that is needed to obtain the certificate of occupancy.
- Insulation, air barrier, windows, HVAC, Duct leakage, moisture management and more will be inspected.
- Action item reporting after each inspection.



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Four Steps of IECC Performance Compliance Simulated Performance Path or Energy Rating Index

Step 3

Final Inspection:

- Diagnostics - Blower door air tightness and duct leakage to outside
- Attic and foundation insulation
- Controlled whole house mechanical ventilation / Spot Ventilation
- Action item reporting after each inspection.

Step 4

Modeling and Certification

- Making the from plans analysis address and lot/site specific including the details of what has been inspected at rough and final
- Generate required code compliance certificates and reports for C.O
- Homes using the Simulated Performance Path receive a cost compliance report, and other required reports
- ERI Score is a byproduct on code compliance using the SPP



energyLogic



Thank you!

Robby Schwarz
Robby@nrglogic.com
www.nrglogic.com

720-838-0677



energyLogic



Home Energy Rating Certificate		Rating Date: 9/29/2016	energyLogic
Projected Report		Registry ID: Unregistered	
Rating Number:			
HERS® Index Score: 63 Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.hersindex.com		Annual Savings \$1,597 <small>*Relative to an average U.S. home</small>	
Home: 8925 Place to live, Denver, CO Builder: Best Builder In America Homes		This home meets or exceeds the criteria of the following: Energy Star v3 Energy Star v3.1 2006 International Energy Conservation Code 2009 International Energy Conservation Code 2012 International Energy Conservation Code 2015 International Energy Conservation Code	
Your Home's Estimated Energy Use:			
	Use [MBtu]	Annual Cost	
Heating	59.7	\$626	
Cooling	2.5	\$88	
Hot Water	18.9	\$172	
Lights/Appliances	32.1	\$1,050	
Service Charges		\$0	
Generation (e.g. Solar)	0.0	-\$0	
Total:	113.1	\$1,936	
Home Feature Summary:			
Home Type: Single family detached Conditioned Floor Area: 3,560 sq. ft. Number of Bedrooms: 4 Primary Heating System: Furnace • Natural Gas • 92.5 AFUE Primary Cooling System: Air Conditioner • Electric • 13 SEER Primary Water Heating: Water Heater • Natural Gas • 0.62 Energy Factor House Tightness: 3 ACH50 Duct Leakage to Outside: 0 CFM25 Above Grade Walls: R-23 Ceiling: R-38 Window Type: U-Value: 0.340, SHGC: 0.280 Foundation Walls: R-11			
Rating Completed by: Energy Rater: Robby Shwarz RESNET ID: 9124083 Rating Company: energyLogic PO Box N Berthoud, CO 80513 (970) 556-0839 Rating Provider: energyLogic PO Box N Berthoud, CO 80513 (970) 556-0839			
Robby Shwarz, Certified Energy Rater			
ekotrope™			
The Home Energy Rating Standard Disclosure for this house is available from the rating provider. Ekotrope HERS Rating Tool - Version: 2.1.0.1787 This report does not constitute any warranty or guarantee.			

Home Energy Rating Certificate		Rating Date:	ekotrope
Confirmed Report		Registry ID: 631462669	
Rating Number: 631462669			
HERS® Index Score: 47 Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.hersindex.com		Annual Savings \$5,912 <small>*Relative to an average U.S. home</small>	
Home: 123 Fake St, Anytown, CO Builder: Ekotrope		This home meets or exceeds the criteria of the following: Energy Star v3 Energy Star v3.1 2006 International Energy Conservation Code 2009 International Energy Conservation Code 2012 International Energy Conservation Code 2015 International Energy Conservation Code	
Your Home's Estimated Energy Use:			
	Use [MBtu]	Annual Cost	
Heating	77.0	\$2,182	
Cooling	0.9	\$53	
Hot Water	17.1	\$240	
Lights/Appliances	36.0	\$1,944	
Service Charges		\$0	
Generation (e.g. Solar)	23.1	-\$2,689	
Total:	131.1	\$1,730	
Home Feature Summary:			
Home Type: Single family detached Conditioned Floor Area: 4,500 sq. ft. Number of Bedrooms: 4 Primary Heating System: Furnace • Natural Gas • 95 AFUE Primary Cooling System: Air Conditioner • Electric • 16 SEER Primary Water Heating: Water Heater • Natural Gas • 0.67 Energy Factor House Tightness: 1660 CFM50 / 2.25 ACH50 Duct Leakage to Outside: 0 CFM25 Above Grade Walls: R-21 Ceiling: R-50 Window Type: U-Value: 0.310, SHGC: 0.250 Foundation Walls: R-11			
Rating Completed by: Energy Rater: Test Rater RESNET ID: 5459458 Rating Company: Ekotrope Rating Co. Rating Provider: Ekotrope Provider			
Test Rater, Certified Energy Rater			
ekotrope™			
The Home Energy Rating Standard Disclosure for this house is available from the rating provider. Ekotrope HERS Rating Tool - Version: 2.0.0.1590			