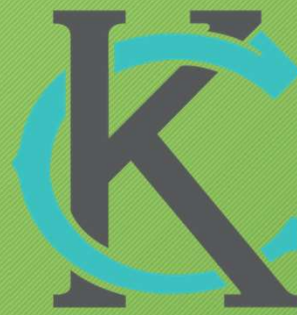




**Metropolitan**  
ENERGY CENTER



CITY OF  
KANSAS CITY,  
MISSOURI

# Energy Codes

## History and Future - Nationally and in KC Area

What are the Residential Energy Codes and How Have They Changed?  
What can we expect in the future for the Kansas City Metropolitan Area?

Sharla Riead, EnergySmart Institute



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# Agenda / Topics

- Welcome and Introductions
- The Energy Code, a brief history
- What is the Energy Code adopted by KCMO?
- The Future of Energy Codes Nationally
- The Future of Energy Codes in Missouri
- Open Discussion



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# Sharla Riead

- ICC Preferred Education Provider
- Accredited Training Provider - RESNET
- ICC/HERS Compliance Specialist
- ICC Certified Residential Energy Inspector
- ICC Certified Plans Examiner
- Quality Assurance Designee - RESNET
- Certified HERS Rater
- Certified Green Rater
- Chair, Standards Development Committee 200 - Training - RESNET
- Member, Standards Development Committee, Remote Inspection of Homes - ICC/RESNET/ANSI



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# What's an IECC?



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# Building Energy Codes

IBC - International Building Code  
IRC - International Residential Code (Ch. 11: EE)  
IECC - International Energy Conservation Code



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# Building Energy Codes

## **Insulation**

R-Values and  
Installation

## **Air Sealing/Infiltration**

Attic Hatches

Doors

Fireplace Doors /  
Flue

Recessed Lighting

Weather-Stripping

## **Heating/Cooling System**

Sizing

Controls

Ductwork

Location

Sealing

Insulation

## **Mechanical Ventilation**

ASHRAE Calculations

Performance Testing

## **Lighting**

**Windows, Doors and  
Skylights**

## **Other:**

Water Pipe Insulation

Sunrooms

Snow Melt Systems

Pools

Heaters

Timers

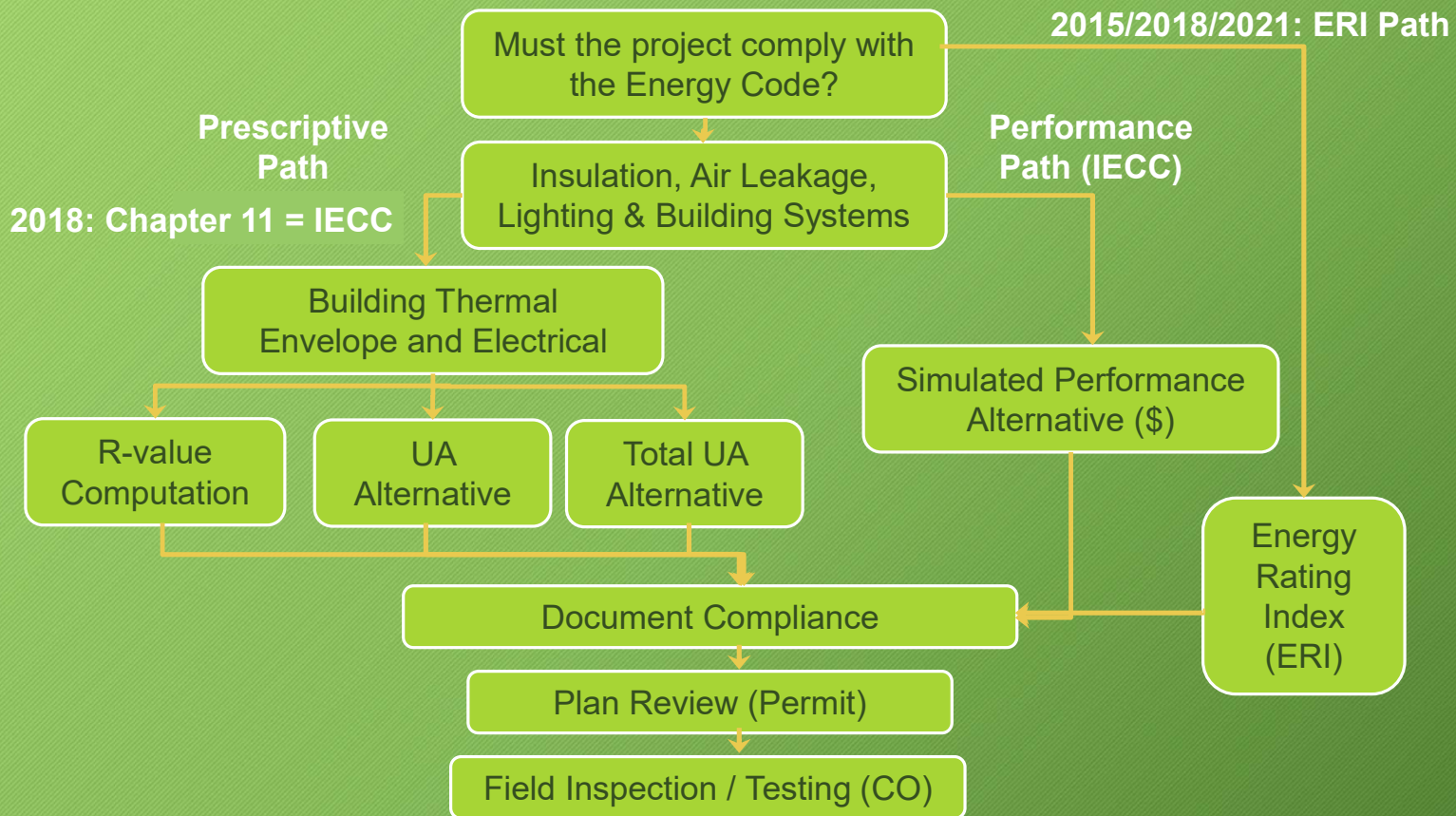
Covers



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# Paths to Code Compliance



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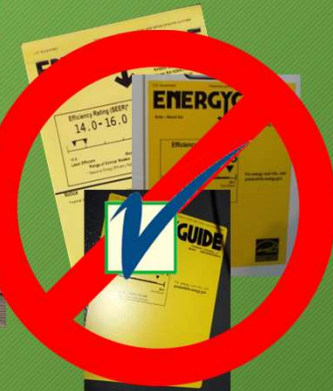


# Paths to Code Compliance

**Prescriptive:** Meet all minimum required levels

**Performance:** Infiltration and Duct Leakage reductions and Ventilation efficiency can offset envelope deficiencies - No credit for others (until 2021)

**Energy Rating Index:** House as a System - All interactions evaluated



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# Pick Your Path

R401.2.1 Prescriptive Compliance

R401.2.2: Total Building Performance

R402.1.2: U-Factor  
R402.1.3: R-Value

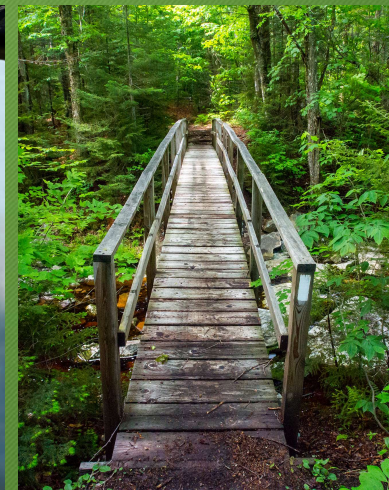
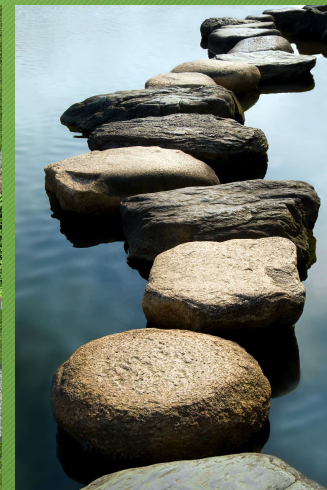
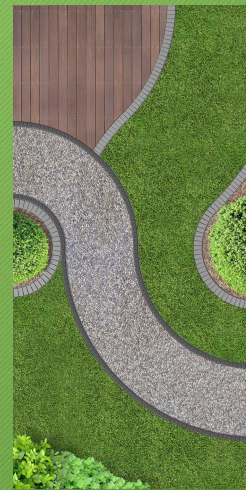
R402.1.5: Total UA

R405.2.2: Cost

R405.2.3: Btu

R401.2.3: ERI

R401.2.4: Tropical

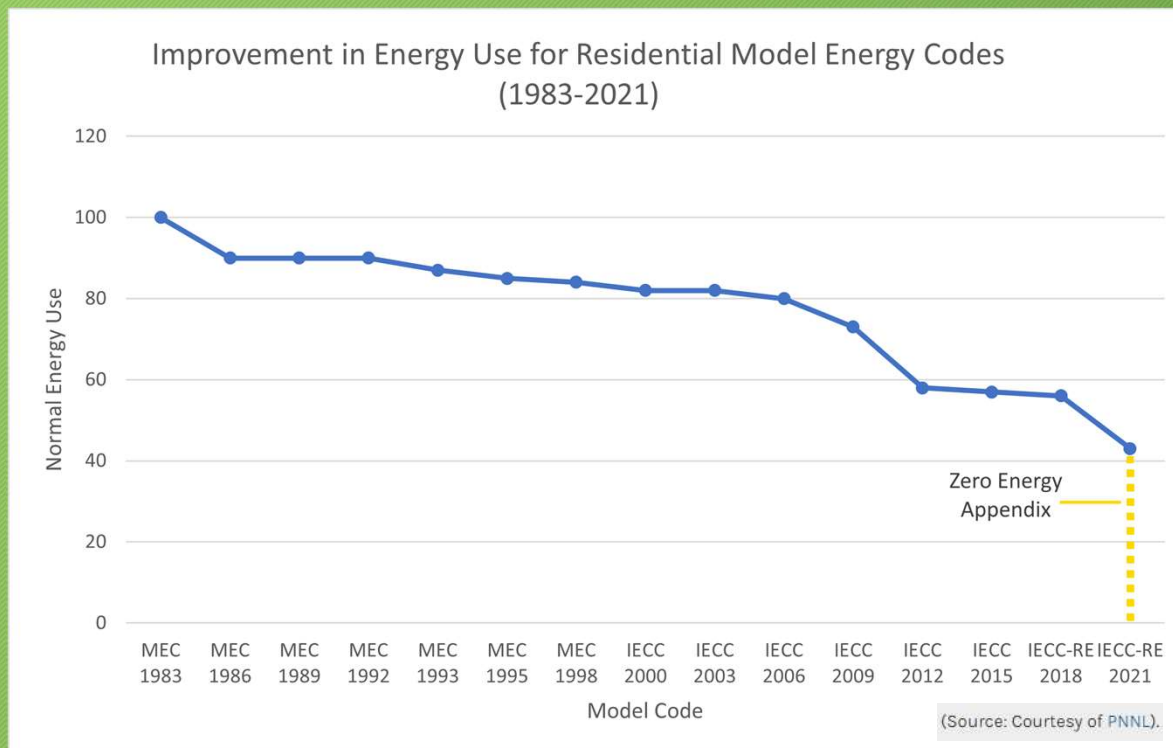


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# Energy Code Objectives

- Establishes Minimum Requirements for Energy Efficient Buildings





# Energy Code Objectives

- Establishes Minimum Requirements for Energy Efficient Buildings
- Results in Healthier Buildings
  - Cleaner combustion and better ventilation
  - Reduced indoor pollution
  - Decreased incidence of asthma, allergies, lung cancer, COPD, other illnesses



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# Energy Code Objectives

- Establishes Minimum Requirements for Energy Efficient Buildings
- Results in Healthier Buildings
- Building Durability
  - Air, Moisture, and Pest intrusion controlled
  - Fire Safety Required
  - Dewpoint Management



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# Energy Code Objectives

- Establishes Minimum Requirements for Energy Efficient Buildings
- Results in Healthier Buildings
- Building Durability
- Building Resiliency
  - Increased Passive Survivability
  - Lower Grid Demand
  - Lower Exposure to event driven price spikes



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# Energy Code Objectives

- Establishes Minimum Requirements for Energy
- Results in Healthier Buildings
- Building Durability
- Building Resiliency
- Energy Equity
  - Each additional \$1 invested on energy efficiency avoids more than \$2 on energy supply spending.
  - Strengthen the financial security of families by lowering energy bills and healthcare costs.
  - Particularly important for the lowest income urban residents, who pay a larger portion of their income on energy and are least able to afford higher energy prices or cope with unexpected fluctuations in energy costs.



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# Energy Code Objectives

## Housing/Utility Cost Burdens

### Energy Cost Burden in KCMO



Among 48 metropolitan areas, KCMO is ranked 7<sup>th</sup> highest for energy spending as a proportion of household income ("energy burden"), with 4.5% of income being spent on energy costs



For renter households, KCMO ranks 6<sup>th</sup> highest, with an energy burden of 6.1% of income



For low-income households, KCMO ranks 9<sup>th</sup> highest, with an energy burden of 8.5% of income

Source: Lifting the High Energy Burden in America's Largest Cities, ACEEE, April 2016

### Percentage of Households that are Cost-Burdened (>30% of income on housing) by Income Groups



■ Owners ■ Renters



Source: 2011-15 ACS Estimates, US Census



# What is the new KCMO Energy Code?



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# What's New? 2009/2012 IECC -> 2021 IECC

- Increases in R-Values/Decreases in U-Values
  - R-Value mark readily observable or Certificate
  - Air-Impermeable Insulation Determination
- “Mandatory” items no longer exist
  - Replaced with a table of required items
- Additional Energy Efficiency Requirements for all paths
- Solar Ready and Zero Energy Provisions in appendix
- New Language in the Air Barrier, Air Sealing, and Insulation Installation Component Sections



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# What's New? 2009/2012 IECC -> 2021 IECC

- Maximum Air Leakage rate for all compliance paths
- Ducts shall be pressure tested regardless of location / Insulation based on location
- Eave Baffle requirements / Attic Hatch design and requirements
- Ventilation System Fan Efficacy requirements
- Lighting Efficacy definition and 100% high efficacy required, plus controls
- Hot Water Distribution Compactness Factor



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# Increased Thermal Efficiency

- Table 402.1.2 and 402.1.3

Climate Zone	Fenestration U-Factor	Skylight U-Factor	Glazed Fenestration SHGC	Ceiling U-Factor	Wood Frame Wall U-Factor	Mass Wall U-Factor	Floor U-Factor	Basement Wall U-Factor	Crawl Space Wall U-Factor	
4 Except Marine	0.30 (0.35)	0.55	0.40	0.024 (0.026)	0.045 (0.082)	0.098 (0.141)	0.047	0.059	0.065	
				Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value	Floor R-Value	Basement Wall R-Value	Crawl Space Wall R-Value	Slab R-Value & Depth
4 except Marine				60 (49)	30 or 20 + 5ci or 13 + 10ci or 0 + 20ci (13)	8/13 (5/10)	19	10ci or 13	10ci or 13	10ci, 4ft (10ci, 2ft)



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# Increased Thermal Efficiency

## R402.2.1 Ceilings with attic

- R-49 over 100% of the ceiling/attic area satisfies R-60
- Full Height, Uncompressed R-49 must extend over the wall top plate at the eaves



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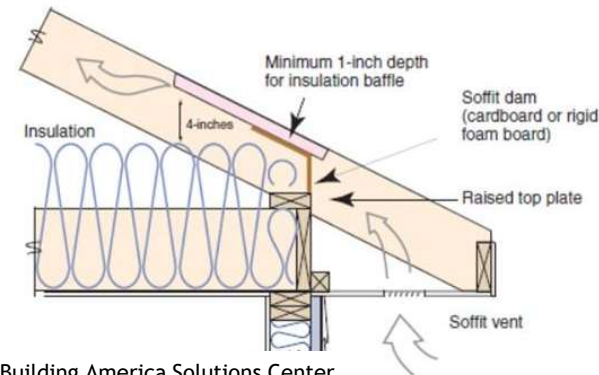


Image Courtesy of Building America Solutions Center



Image Courtesy of The Engineered Wood Association

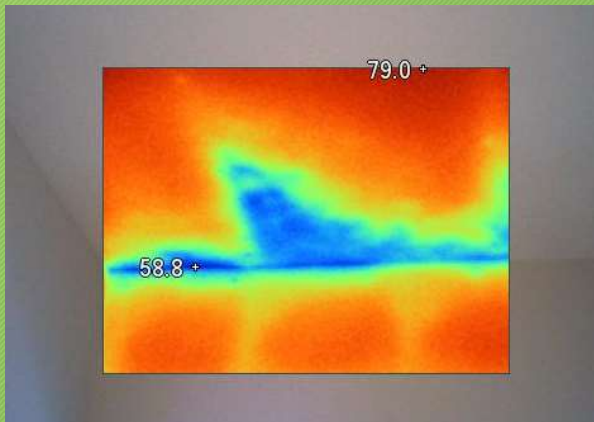


Image Courtesy of Building America Solutions Center



# Insulation Evaluation: Ceiling

- Effective Air Barrier Required
  - For Air Permeable Insulation
  - Wind Block, Air Chute or Eave Baffle
  - Installed in every bay and sealed





# Insulation Evaluation: Ceiling

- Effective Air Barrier Required
  - For Air Permeable Insulation

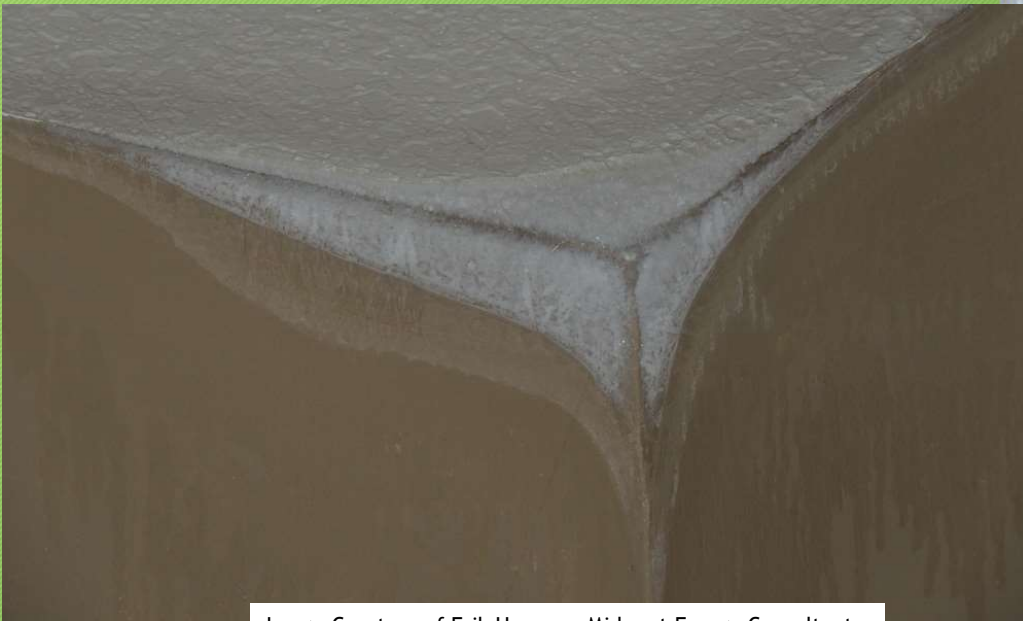


Image Courtesy of Erik Henson - Midwest Energy Consultants





# Air Barrier/Air Sealing/Insulation Components

New and updated components

- Rim Joists
- Basement, Crawl Space and
- Shafts, Penetrations - Added
- Narrow Cavities - Added air
- Garage Separation - Added
- Recessed Lighting - Added in
- Plumbing, Wiring or Other C



Images Courtesy of Krissa Albert - Central Energy Audits



# Air Leakage

- R402.4.1.2 Testing.
  - The building or dwelling unit shall be tested for air leakage
  - Maximum Air Leakage under any compliance path shall not exceed 5.0 ACH or 0.28 CFM/square foot of dwelling unit enclosure area
  - Exception allowing 0.30 CFM/sf enclosure area:
    - Attached single and multiple family buildings and dwelling units
    - Buildings or dwelling units that are 1,500sf or smaller
- R402.4.1.3: Prescriptive Path air leakage rate shall not exceed 3.0 ACH in CZ 3 through 8





# Duct Leakage / Insulation

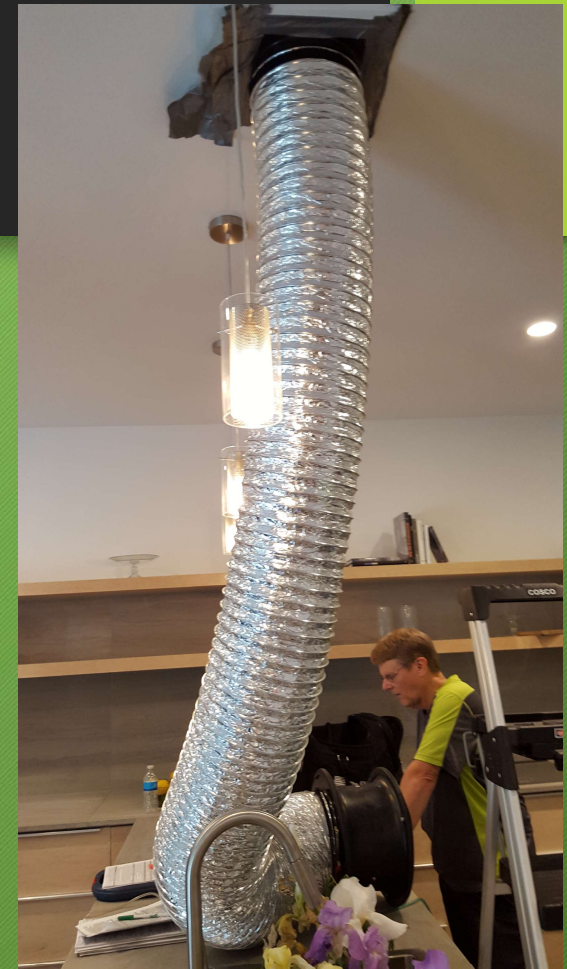
- R403.3.1 Ducts located outside conditioned space.
  - R-8 for ducts 3 inches or larger, R-6 for smaller ducts - ALL unconditioned, not just attics
- R403.3.2 Ducts located in conditioned space.
  - Ductwork in floor cavities located over unconditioned space
    - Must have continuous air and thermal barrier on unconditioned side
    - R-19 minimum separating ducts from unconditioned space
  - Ductwork in exterior walls
    - Must have continuous air and thermal barrier on unconditioned side
    - R-10 minimum separating ducts from unconditioned space
    - Remainder of cavity insulation fully insulated to the drywall side





# Duct Leakage / Insulation

- R403.3.5 Duct testing
  - Ducts shall be pressure tested in accordance with ANSI/RESNET/ICC 380 or ASTM E1554
    - No Exception for ducts and air handlers located fully within the building thermal envelope
  - Written report of test results signed by tester and provided to code official
- R403.3.6 Duct leakage
  - Rough-in test: Total Leakage less than or equal to 4cfm/100sf cfa (if air handler installed)
  - Rough-in test: Total Leakage less than or equal to 3cfm/100sf cfa (if no air handler)
  - Postconstruction test: Total Leakage less than or equal to 4cfm/100sf cfa (ducts outside)
  - Postconstruction test: Total Leakage less than or equal to 8cfm/100sf cfa (ducts and air handler entirely within the building thermal envelope - NO CAVITIES!)





# Ventilation System Fan Efficacy

## R403.6 Mechanical Ventilation

- The Building shall be provided with ventilation
- R403.6.2 Whole-dwelling mechanical ventilation system fan efficacy
  - HRV, ERV, Balanced
  - Range Hood
  - In-Line Supply or Exhaust Fan
  - Other Exhaust Fan
  - Air-handler Fan (no longer an exception for ECM)
- R403.6.3 Testing
  - Mechanical Ventilation systems shall be tested and verified to provide the required ventilation rates





# Mechanical Ventilation Systems

- Mechanical Ventilation is required
  - HRV or ERV required in CZ 7 and 8
  - System Fan must be efficient
  - Airflow must be tested
- 
- Best Practice in CZ 4 and 5: HRV
    - Dry Winters
    - Humid Summers



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# Domestic Water Heating Systems



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# Domestic Water Heating Systems

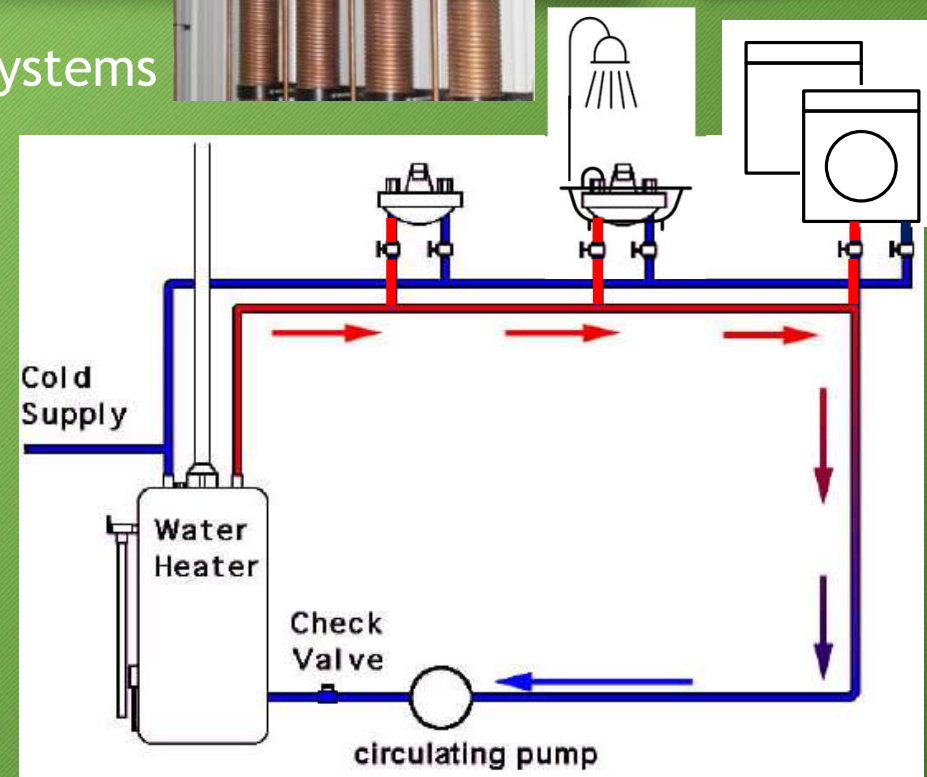
- Circulation and Temperature Maintenance Systems

- Must have Circulation Pump with Controls to stop circulation at temp
- Must control water temperature
- Automatic Controls Accessible
- Manual Controls - Ready Access

- Pipe Insulation: R-3 or greater

- DWHR

- Pressure Loss:
  - <3psi 1-2 showers
  - <2psi 3+ showers





# Hot Water Distribution Compactness Factor

No Credit for Lighting, Appliances, Heating & Cooling Equipment, On-Site Power Generation, However...

Table 405.4.2(1) note i

- Provides credit for compactness of hot water distribution
  1. Locate the water heater and the hot water fixtures and appliances
  2. Draw a rectangle through the center line of the water heater and the plumbing walls next to the hot water fixtures and appliances
  3. Calculate the area of the rectangle
  4. Divide this area by the cfa of the home to get the Compactness Ratio
  5. Determine if a credit can be taken and how large it can be



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# Hot Water Distribution Compactness Factor



## 1-STORY, 3 BEDROOM, 2 BATH

1. CONDITIONED FLOOR SPACE 1,147 SF
2. HOT WATER SYSTEM RECTANGLE:  $36 \times 23 = 828$  SF
4. COMPACTNESS RATIO:  $828/1,147 = 72\%$
5. HWDS FACTOR FOR 1-STORY: 0.0



## 1-STORY, 2 BEDROOM, 2 BATH

1. MOVE THE WATER HEATER INTO THE CORNER NEAR THE CENTER OF THE GARAGE
2. CONDITIONED FLOOR SPACE 1,147 SF
3. HOT WATER SYSTEM RECTANGLE:  $25 \times 23 = 575$  SF
4. COMPACTNESS RATIO:  $575/1,147 = 50\%$
5. HWDS FACTOR FOR 1-STORY: 0.05

HWDS = Service Water Heating savings for proposed design over reference design - 0%, 5%, 10%, or 15%

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# Efficient Lighting

- High Efficacy Lighting
  - Definition Updated
  - 2012 = 75%
  - 2021 = 100%
- Interior Lighting Controls
  - Dimmer
  - Occupant Sensor
- Exterior Lighting Controls
  - Automatic Shut Off
  - Daylight Sensor



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# Additional Efficiency Package

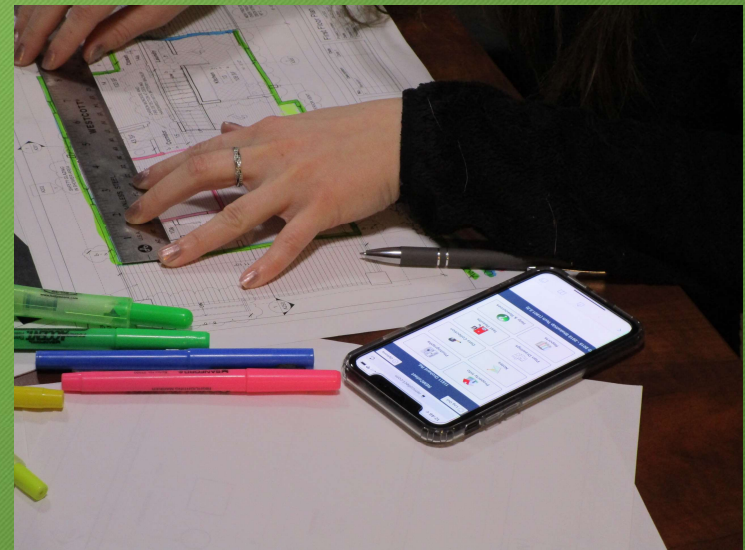


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## R401.2.5 Additional Energy Efficiency

- Prescriptive: Choose from the list in R408.2
- Performance:
  - Choose from the list in R408.2 - exclude chosen item from design compliance calculations
- OR
- 5% Reduction in Energy Cost
- ERI: Final ERI  $\leq$  Table R406.5 ERI - 5
  - Final ERI CZ 4: 49
  - Final ERI CZ 5: 50



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# R408 Additional Efficiency Package Options

- R408.2.1 Enhanced Envelope Performance
  - Envelope and Area Weighted SHGC are 5% better than the Table R402.1.2
- R408.2.2 More Efficient Heating and Cooling Equipment
  - $\geq 95$  AFUE Furnace and 16 SEER AC
  - OR
  - $\geq 10$  HSPF / 16 SEER ASHP
  - OR
  - $\geq 3.5$  COP GSHP



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# R408 Additional Efficiency Package Options

- R408.2.3 More Efficient Water Heating Equipment
  - $\geq 0.82$  EF Gas Water Heater
  - OR
  - $\geq 2.0$  EF Electric Water Heater
  - OR
  - $\geq 0.4$  Solar Fraction Solar Water Heater



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# R408 Additional Efficiency Package Options

- R408.2.4 More Efficient Duct Thermal Distribution System
  - 100% of Ducts and Air Handlers Located Entirely within the Building Thermal Envelope
- OR
- 100% of Ductless Thermal Distribution or Hydronic Thermal Distribution System Located Entirely within the Building Thermal Envelope
- OR
- 100% of Duct Thermal Distribution System Located in Conditioned Space as Defined by Section R403.3.2



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# Ducts In Conditioned Space

- Located completely within the Continuous Air and Thermal Barrier
- Located in Ventilated Attic space and Buried:
  - Air handler located completely within the continuous air barrier AND thermal envelope
  - Tested Leakage  $\leq 1.5\text{cfm}_{25}/100\text{sf}$  To Outside
  - Ceiling insulation R-Value at ducts is  $\geq$  Ceiling R-Value - Duct R-Value but not less than R-19 above, below, and beside the ducts
  - Supply and Return Ducts  $\geq$  R-8



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# R408 Additional Efficiency Package Options

- R408.2.5 Improved Air Sealing and Efficient Ventilation System

- $\leq 3.0$  ACH50

AND

- ERV or HRV Installed

- $\geq 75\%$  SRE at Lowest Airflow  
(Sensible Recovery Efficiency)
    - $\leq 1.1$  cfm/watt Fan Efficiency
    - Shall not use Recirculation as a Defrost Strategy
    - If ERV:  $\geq 50\%$  LRMT  
(Latent Recovery/Moisture Transfer)



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# Clean Energy Systems

- Photovoltaic
- Electric Vehicle Charging
- Solar Ready / Zero Energy



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# Clean Energy Systems

- Photovoltaic
  - PV Systems - Solar Electric
  - ERI Path Item
  - RECs retained by Homeowner
  - Limited to 5%
  - Envelope must be at least as efficient at 2015 IECC



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# Electric Vehicle Charging Stations

- ERI Path Item
- Not included in Energy Use



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# Solar Ready/Zero Energy

- Optional Appendix RB and RC
- Solar Ready
  - Roof space reserved for Solar PV or Solar Thermal System
  - Correct Orientation / Unshaded / Roof Load documentation
  - Electrical Service space reserved for Solar Electric
  - Conduit interconnection and Capped Roof Penetration Sleeve
- Zero Energy
  - Stringent ERI value before Onsite-Power Production (OPP)
  - ERI max 0 with OPP, adjusted to include Community and Purchased Renewables



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# What's Next? The 2024 IECC and Beyond

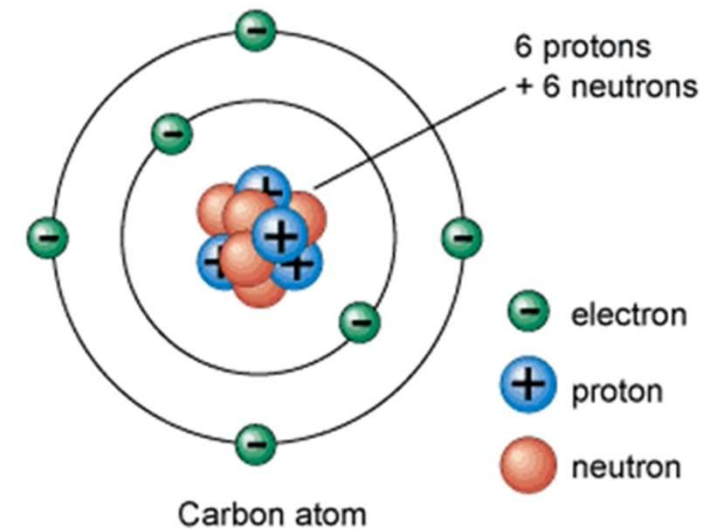


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# Focus on Carbon

- Carbon in Energy Provided
  - Site vs. Source Accounting
  - Natural Gas vs. Electric vs. Other
- Operational Carbon
  - Energy Use
  - Refrigerant Leakage
- Embodied Carbon
  - Materials
  - Sourcing



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# Focus on Resiliency

- Disaster Resistance
- Shelter-in-Place - Passive Survivability
- Energy Storage
- Distributed Energy
- Code Adoption and Enforcement



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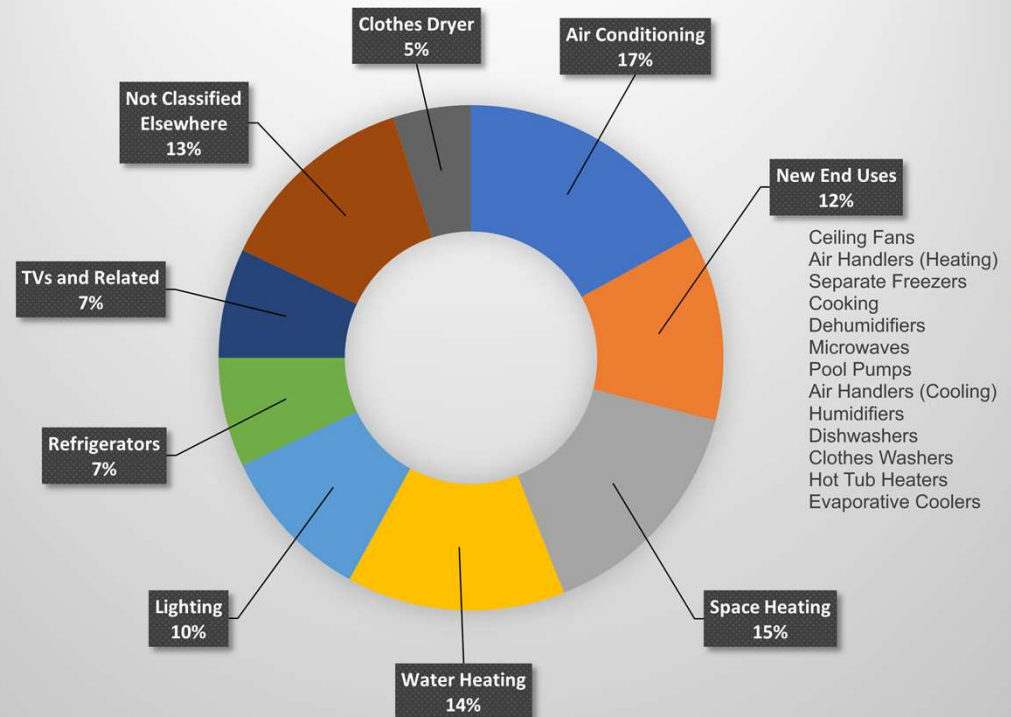




# Focus on Energy

- Fan Energy
- Mandate Duct Locations
- Credit for Energy Storage
- Credit for EV Ready
- Peak Load Limitations
- Zero Energy
- Solar Ready
- Electrification Ready

Residential Electricity Consumption by End Use, 2015



Residential Building Energy Use



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# Compliance Equity

- Smart Backstops vs. Punitive Backstops
  - ERI is only Performance Path not at 2009 IECC
- ERI to follow Standards - fix Mechanical Ventilation Issue - Move from an “IECC R406 compliance score” to a true ERI
- Leveled Stringency Requirements
- Mechanical Efficiency - Keep Federal or Move to Code?
- Additional Efficiency Option Packages



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# What does the Future Hold for Missouri Energy Codes?



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# Model Codes vs the Law

- IRC and IECC are “Model Codes”
  - Provided as models for jurisdictions to use / amend as they find appropriate
- Local Building Codes are the Law
  - Code Officials have the final say
  - Code Officials have the authority to interpret
  - Energy Professionals and other Third-Parties must be approved by the Code Official



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# House Bill 580

- Ignores Missouri's history as a Home Rule state
- Prohibits codes with wood frame wall cavity insulation greater than R-13
- Makes it illegal to have the effect of requiring the utilization of exterior continuous insulation
- Outlaws a maximum air leakage rate less than five air changes per hour
- Bans a requirement for ceiling insulation greater than R-38
- Requires that the use of framed cavities as ducts or plenums be allowed



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# House Bill 580

- Introduced: January 04, 2023 - Dan Houx, District 54
- Referred to Government Efficiency and Downsizing: January 19, 2023
- Public Hearing Held: February 1, 2023 - 93% of public testimony against
- Passed out of Committee: February 22, 2023
  - Ayes (9): Baker (R), Chappell (R), Davis, Lovasco (R), Murphy (R), Riggs (R), Schulte (R), Schwadron (R), and Van Schoiack (R)
  - Noes (3): Bangert (D), Sauls (D), and Strickler (D)
  - Present (1): Nickson-Clark (D)
  - Absent (1): Boggs (R)
- Referred to Rules - Legislative Oversight: February 23, 2023
- Next Hearing: February 27, 2023 - Rules - Legislative Oversight (Executive Session)



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# Questions? Discussion?

[Sharla@EnergySmartInstitute.com](mailto:Sharla@EnergySmartInstitute.com)



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