



Residential Code and Building Applications 2018/2021/2024

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Housekeeping

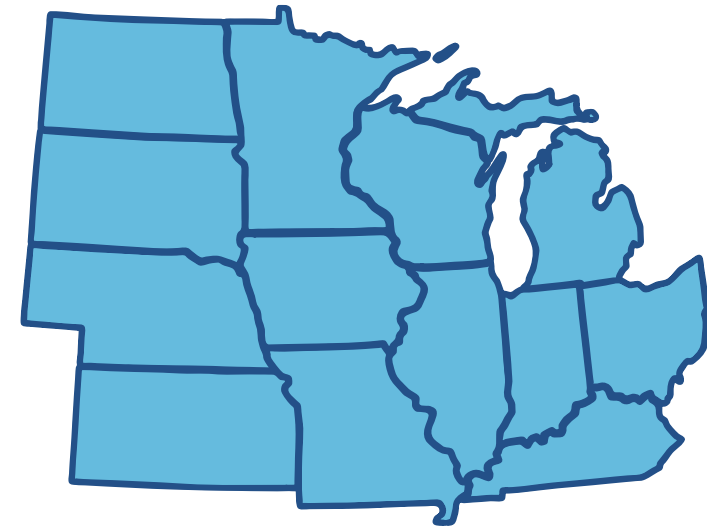
- Attendees are muted upon entry
- Questions? Enter them in the chat box or unmute
- Webinar is being recorded – slides and recording will be sent to attendees and posted on website
- CEUs from ICC and AIA provided
- Email jgossman@mwalliance.org with questions



Midwest Energy Efficiency Alliance

The Midwest Energy Efficiency Alliance (MEEA) is a collaborative network, promoting energy efficiency to optimize energy generation, reduce consumption, create jobs and decrease carbon emissions in all Midwest communities.

MEEA is a non-profit membership organization with 150+ members, including:



Energy service
companies &
contractors



State & local
governments



Academic &
research institutions



Electric &
gas utilities

About the Nebraska Training Program

- Goal: prepare the Nebraska workforce for upcoming changes in construction best practices
 - Residential and Commercial Energy Code
 - Building Science
 - Practical Solutions
- Focused on providing training to builders, code officials, design professionals, public officials and students
- For more information, visit:
<https://www.mwalliance.org/nebraska-energy-codes-training-program>



Residential Energy Code Basics/Requirements

- Basic Code Requirements (2009-2018).
- Changes/Updates to Energy Code for 2021.
- '24 National Energy Standard
- Basic Building Science; THE Thermal Envelope & Components
- Compliance Paths (Prescriptive) Performance (EFI)
- Performance Testing
- Checklists
- How we sell it!





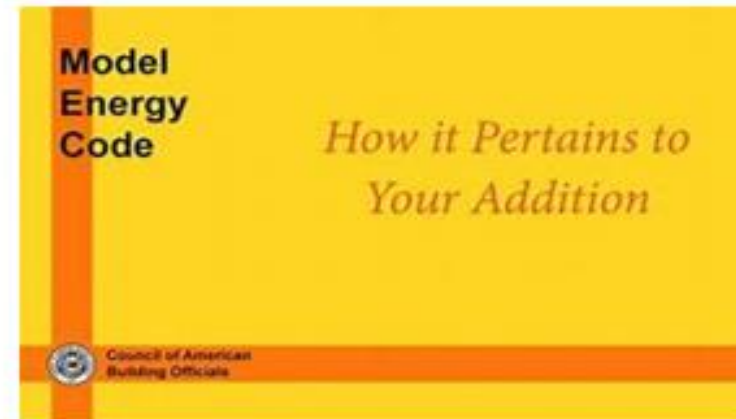
Codes:

- Updated energy codes and where we are now.
- Always remember: Codes are Minimums!.
- Energy Code requires tightness/Performance levels
- Residential Code delineates structure and assembly, etc.
- Neither contain details.
- Today's homes are built to higher efficiency standards based on building science principles that improve building performance.
- Lack of knowledge or attention to detail could yield unintended consequences in a home's operation, indoor environment or durability.

Building/Energy Code History

- Energy Code Formation

1983 Model Energy Code Introduced as a response to “Energy Crises” of 1970s.



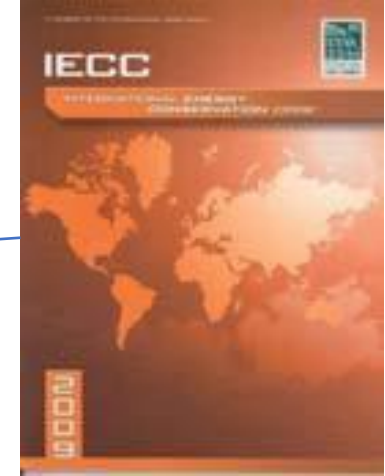
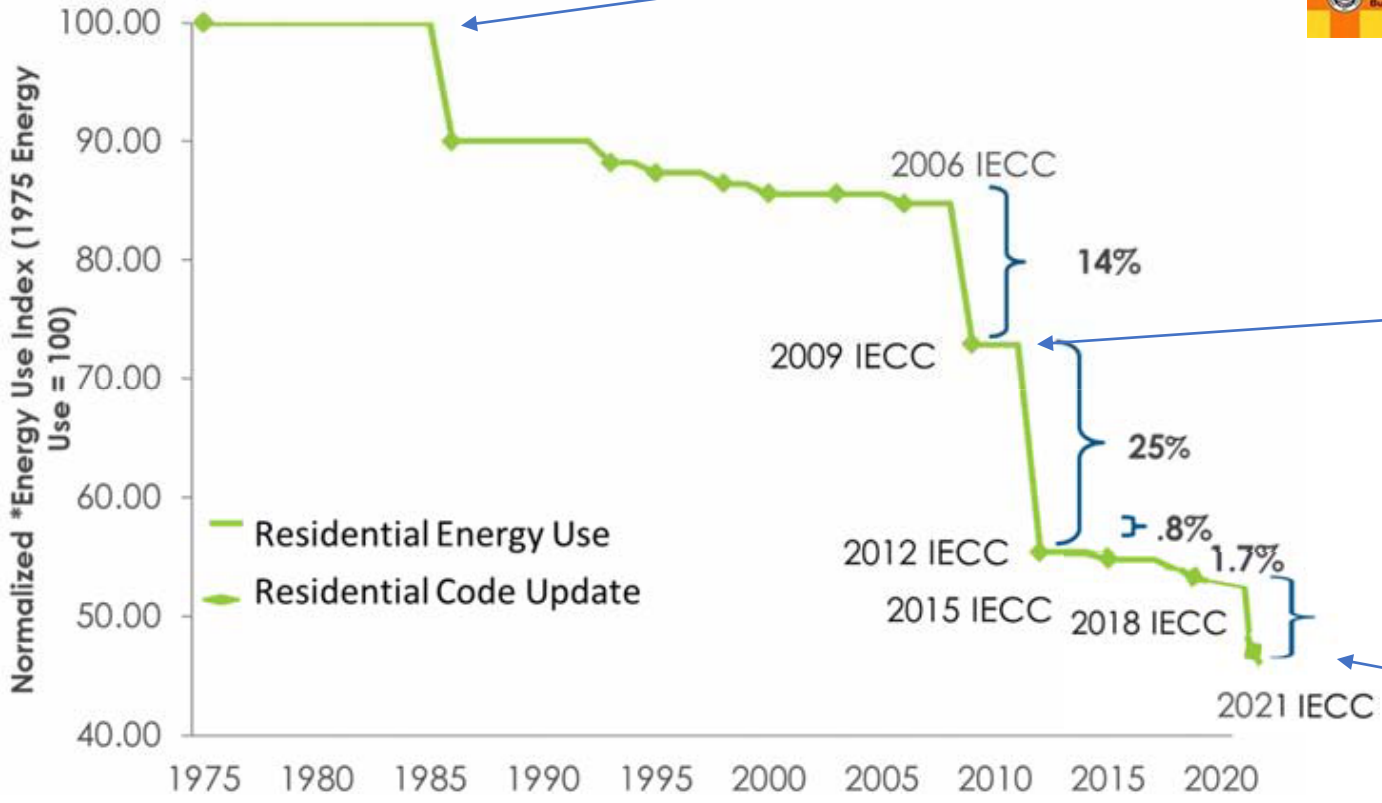
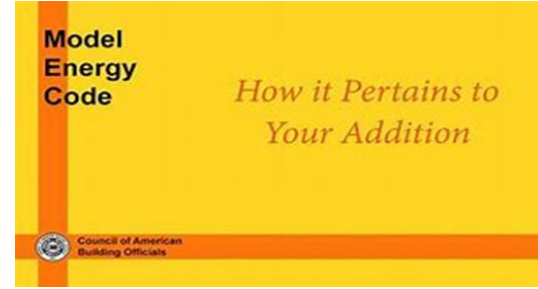
How we got here; Energy Standards (and/or Green Building)

EPA's **Energy Star** program;

- Launched in 1992 for Appliances
- In 1995 EPA launched Energy Star for Homes
Homes Built 15% more efficient than the Model Energy code
- In 1996 Energy Star became formal partnership between EPA and D.O.E.
- Austin Energy Green Building Program; Began in Austin TX in 1991

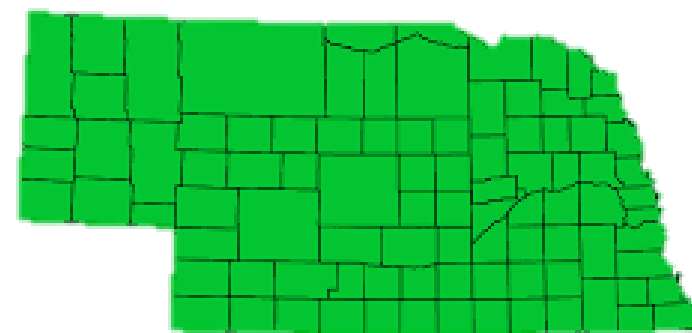
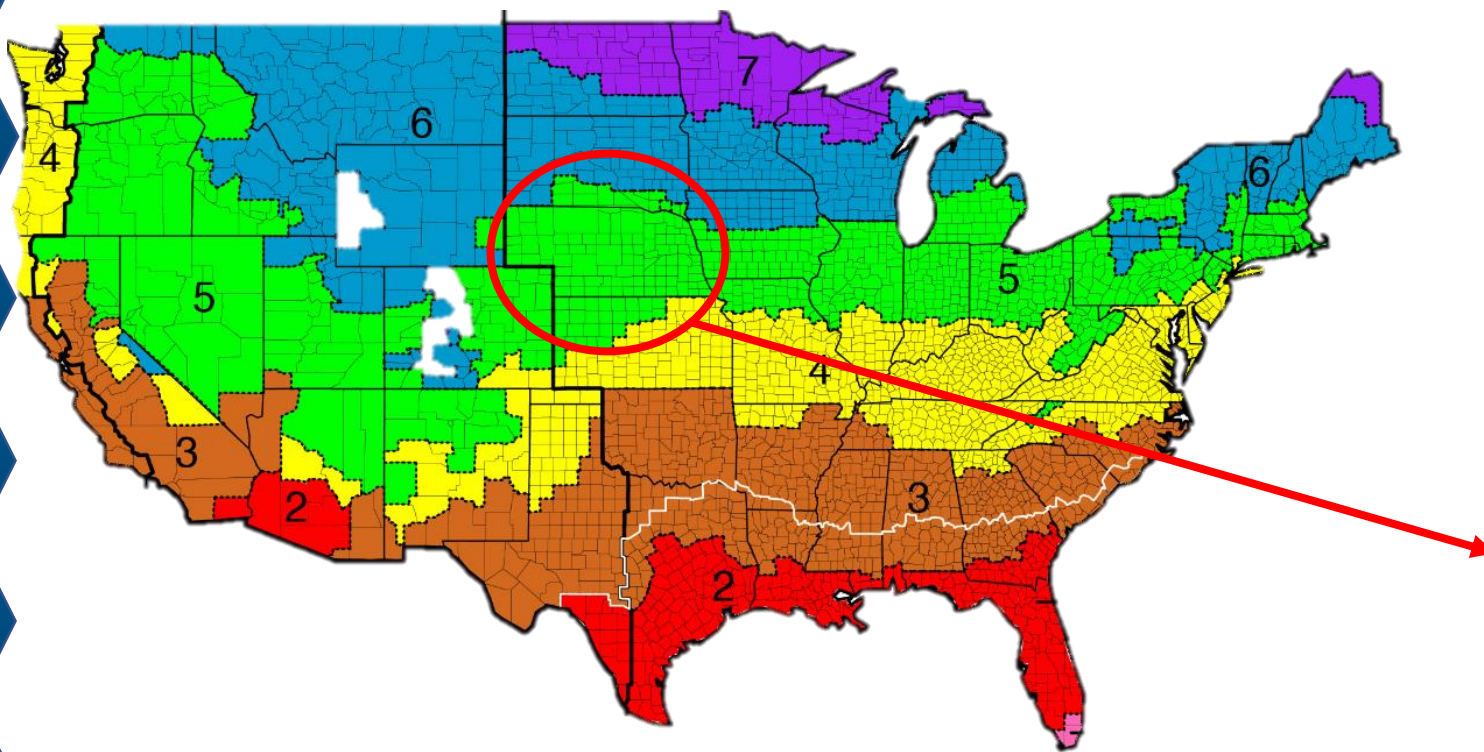


Residential Energy Code Background



Climate Zones

- Nebraska has only one climate zone – 5A
- Cold & Moist climate



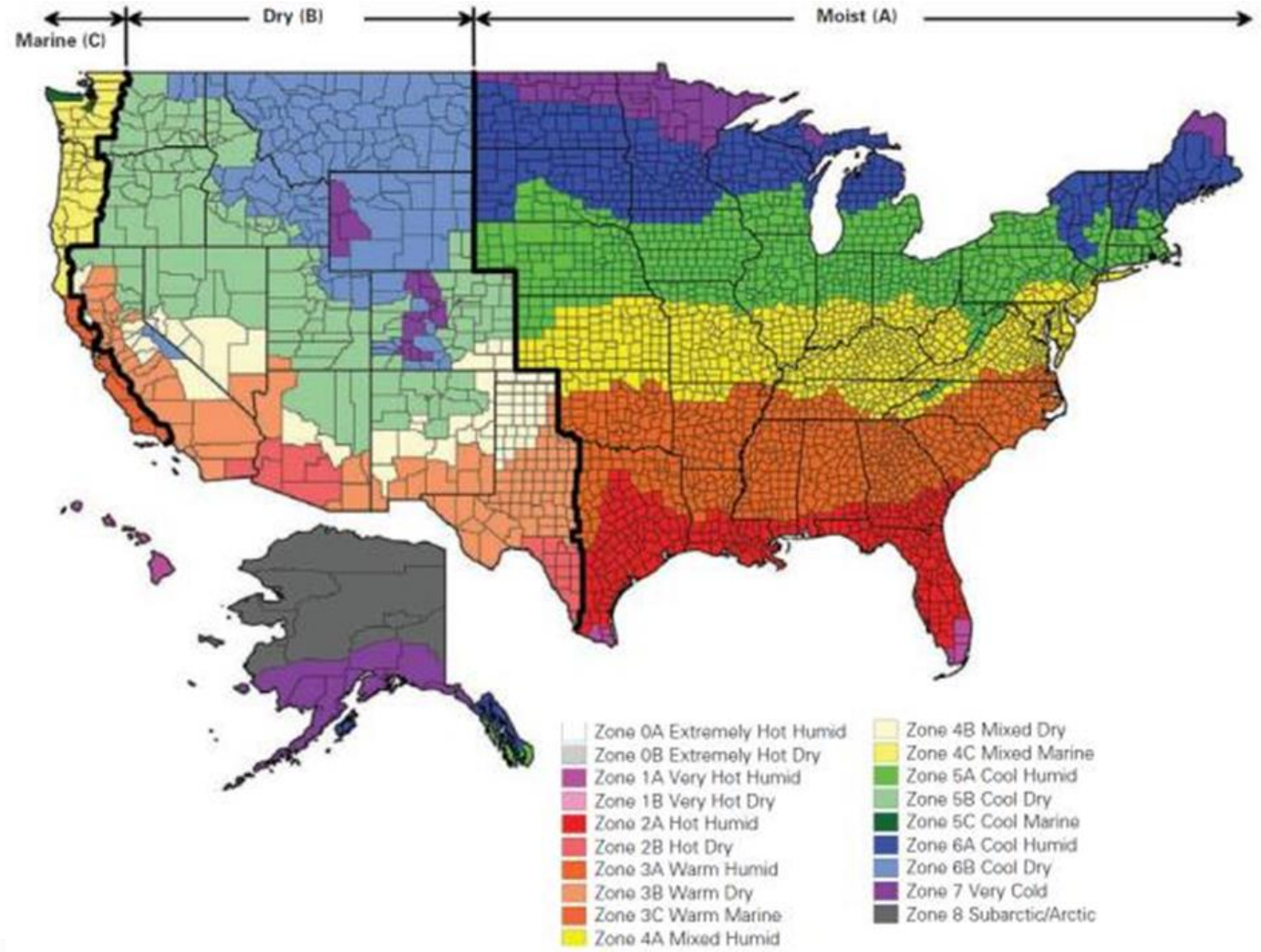


How are envelope requirements determined?

Requirements for building energy codes are linked to the dominate climate within a given jurisdiction, determined by a 30-year average of local surface observations.

Note: Climate zones change! Climate zones change! ASHRAE 90.1-2019 & IECC 2021 have important changes, including a new climate zone (CZ0) and shifts in county designations.

Question: Why should you (or a building owner/operator) care?



The Energy Code is Everywhere

- Unlike most other codes, the energy code directly impacts the work of many disparate building trades and systems, including:
 - Framing/Envelope
 - Plumbing
 - HVAC
 - Electric
 - Moisture management
 - Concrete
 - Caulking



2018 IECC / IRC Section 11

- **Basics:**
 - **Separates Commercial and Residential**
- **Remains +/- 15% above 2012 IECC**
- **Testing and verification.**
- **Promotes Innovation through Criteria; Energy Ratings Index (ERI) and 3 other alternative methods**



Key Energy Code Components

- Insulation R-value (ceiling, wall, foundation)
- Insulation installation quality
- Continuous air barrier/sealing and testing
- Efficient windows
- Mechanical ventilation
- HVAC system sizing location detailing
- Envelope testing
- Efficient lighting & verification testing



IECC - Residential Provisions (All-Electric)

- **Chapter 1 – Scope and Application R101 SCOPE AND GENERAL REQUIREMENTS**

- **R101.3 Intent:**

Intent has been modified to include consideration of greenhouse gas emissions as well as both production and storage of energy.

- **R103 CONSTRUCTION DOCUMENTS**

- **R103.2.3 Solar-ready system**

Revisions to this section incorporate critical elements of solar readiness to be clearly identified on the construction documents. This code language has been migrated and amended from the 2021 IECC Appendix RB Solar-Ready Provisions.



Changes in IECC 2021



- **Administrative**
- R102: More Authority for Code Official to approve alternative material(s). (or not!)
- More definition for Code Officials Approval of Above Code Programs. (or not!)
- Information on Construction Documents must include: Energy Compliance Path and Air Sealing Details and Location of Air Barrier.

IECC - Residential Provisions (All-Electric) (Cont.)

- **R105 INSPECTIONS**

- **R105.2.3 Plumbing rough-in inspection.**

Revisions to this section incorporate critical elements of solar readiness used for service water heating.

- **R105.2.5 Electrical rough-in inspection.**

Current 2021 IECC inspections do not require dedicated electrical inspections.

IECC - Residential Provisions (All-Electric) (Cont.)

- Chapter 4 – Residential Energy Efficiency
- R401 GENERAL
- R401.2 Application. Residential buildings shall be *all-electric buildings*.

The change in application requires that new construction be all-electric. Where a jurisdiction does not wish to require electrification of specific end uses but wants to advance electric buildings further than electric-readiness, exception language can be added.

R401.3 Certificate. *Where a solar-ready zone is provided, the certificate shall indicate the location, dimensions, and capacity reserved on the electrical service panel.*

IECC - Residential Provisions (All-Electric) (Cont.)

- **R403 SYSTEMS:**

- **R403.1.1 Thermostat Programmable thermostat**

Demand responsive controls for thermostats are added based on language from California Title 24 and integrated into the current requirement for thermostats.

- **R403.5.4 Demand responsive water heating.**

- **R404.4 Renewable energy infrastructure.**

By ensuring solar-ready zones, all-electric buildings will have the potential for an even greater impact on building decarbonization by contributing to the continued cleaning of the electricity supply.

IECC - Residential Provisions (All-Electric) (Cont.)

- **R408 ADDITIONAL EFFICIENCY PACKAGE OPTIONS.**

All electric buildings will not need language that relates to fossil fuel systems. This vestigial language has been removed to avoid confusion in implementation of this overlay and the sections have been renumbered.

IECC - Residential Provisions (Mixed-Fuel)

- **Chapter 1 – Scope and Application R101 SCOPE AND GENERAL REQUIREMENTS.**

Intent has been modified to include consideration of greenhouse gas emissions as well as both production and storage of energy.

- **R103 CONSTRUCTION DOCUMENTS**
- **R103.2 Information on construction documents.**

6. Mechanical and service water heating systems and equipment types, sizes, fuel sources and efficiencies.



IECC - Residential Provisions (Mixed-Fuel)

- **R103.2.3 Solar-ready system.**
- **R103.2.4 Electrification system.**

- **R105 INSPECTIONS**
- **R105.2.3 Plumbing rough-in inspection**

Inspections at plumbing rough-in shall verify compliance as required by the code and approved plans and specifications as to types of insulation and corresponding R-values and protection and required controls. Where the solar-ready zone is installed for solar water heating, inspection shall verify pathways for routing of plumbing from solar-ready zone to service water heating system.

IECC - Residential Provisions (Mixed-Fuel)

- **Chapter 4 – Residential Energy Efficiency**
- **R401 GENERAL**
- For all-electric buildings
- For mixed-fuel buildings
- For buildings complying with the Energy Rating Index

- **R402 BUILDING THERMAL ENVELOPE**

Low energy buildings are currently exempt from thermal envelope requirements. This revision applies the same intention of low greenhouse gas impact that was given to low energy use impact when these building types were exempted.

IECC - Residential Provisions (Mixed-Fuel)

- **R404 ELECTRICAL POWER AND LIGHTING SYSTEMS**

- **R404.4.1 One- and two- family dwellings and townhouses.**

One- and two-family dwellings and townhouses shall comply with Sections R404.4.1.1 through R404.4.1.4.

Exceptions:

- 1. A building with a permanently installed on-site renewable energy system.
- 2. A building with a solar-ready zone area that is less than 600 square feet (55 m²) of roof area oriented between 110 degrees and 270 degrees of true north.
- 3. A building with a solar-ready zone area that is shaded for more than 70 percent of daylight hours annually.

IECC - Residential Provisions (Mixed-Fuel)

- **R404.4.1.2 Obstructions.** Solar-ready zones shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.
- **R404.4.1.3 Electrical service reserved space.** The main electrical service panel shall have a reserved space to allow installation of a dual pole circuit breaker for future solar electric installation and shall be labeled “For Future Solar Electric.” The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location.

IECC - Residential Provisions (Mixed-Fuel)

- **R404.4.1.4 Electrical interconnection.** An electrical junction box shall be installed within 24 inches (610 mm) of the main electrical service panel and shall be connected to a capped roof penetration sleeve or a location in the attic that is within 3 feet (914 mm) of the solar ready zone by one of the following:
 - 1. Minimum $\frac{3}{4}$ -inch nonflexible conduit
 - 2. Minimum #10 Metal copper 3-wire. Where the interconnection terminates in the attic, location shall be no less than 12" (35 mm) above ceiling insulation. Both ends of the interconnection shall be labeled "For Future Solar Electric".



IECC - Residential Provisions (Mixed-Fuel)

- **R404.5 Electric vehicle charging infrastructure.** Electric infrastructure for the current and future charging of electric vehicles shall be installed in accordance with this section. EV ready spaces are permitted to be counted toward meeting minimum parking requirements.



IECC - Residential Provisions (Mixed-Fuel)

- **R404.6.3 Combustion space heating.**
- A dedicated branch circuit in compliance with IRC Section E3702.11 based on heat pump space heating equipment sized in accordance with R403.7 and terminating within 3 feet (914 mm) of the location with no obstructions. Both ends of the branch circuit shall be labeled “For Future Heat Pump Space Heater.”

EV Ready and EV Capable

- EV Chargers
 - Level 1 EVSE – Charging through 120V AC plug
 - Adds 2-5 miles of range per hour of charging
 - No special equipment, but does require dedicated branch circuit
 - Level 2 EVSE – Charging through 240 V AC plug
 - Adds 10-60 miles of range per hour of charging
 - Requires special charging equipment and dedicated electrical circuit of 20-100 amps
 - More expensive than Level 1
- EVs can also serve as a home battery in the future



Images: tesla.com; wsj.com

IECC - Residential Provisions (Mixed-Fuel)

- **R404.6.4 Combustion clothes drying.**

- A dedicated 240-volt branch circuit with a minimum capacity of 30 amps shall terminate within 6 feet (1829 mm) of natural gas clothes dryers and shall be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future Electric Clothes Drying” and be electrically isolated.

- **R404.6.5 Combustion cooking.**

A dedicated 240-Volt, 40A branch circuit shall terminate within 6 feet (1829 mm) of natural gas ranges, cooktops and ovens and be accessible with no obstructions. Both ends of the branch circuit shall be labeled with the words “For Future Electric Range” and be electrically isolated.

IECC and IMC

- Whole-house mechanical ventilation required by energy code
- Ventilation rate and equipment requirements in the International Mechanical Code (IMC)





HVAC Design and Loads

Oversized systems:

- Less comfort
- Less efficient
- Poorly handles moisture
- Premature equipment failure

Right-sized systems:

- Better operating efficiencies
- Greater comfort
- Healthier indoor environments
- Better moisture control

HVAC Design and Loads



- Properly designed HVAC systems rely on scientific criteria and a systematic method to match the loads required for health and comfort:
 - *ACCA Manual J – Residential Load Calculation*
 - *ACCA Manual S – Residential Equipment Selection*
 - *ACCA Manual D – Residential Duct Systems*
- Reports should be submitted with permit application



Manual J Software

Right-Suite Residential J8 - [Lanigan-Cape-Cod.rpr: Loads Worksheet]

File Edit View Show Drawing Options Window Help

Right-J8 Worksheet

1 Room name Entire House Basement z

2 Exposed wall 172.0 ft 172.0 ft

3 Ceiling height 10.0 10.0

4 Room dimensions

5 Room area 1741.6 ft² 1741.6 ft²

Ty	Construction number Select any cell then click here	U-value	Or	HTM (Btuh/ft ²)		Area (ft ²) or perimeter (ft)		Load (Btuh)		Area (ft ²) or perimeter (ft)		Load (Btuh)	
				Heat	Cool	Gross	N/P/S	Heat	Cool	Gross	N/P/S	Heat	Cool
6	W 12C-6bw	0.060	ne	2.820	0.759	0	0	0	0	0	0	0	0
	W 15B-0c-6	0.488	ne	13.07	2.996	523	523	6834	1567	523	523	6834	658
	W 12C-6bw	0.060	se	2.820	0.759	0	0	0	0	0	0	0	0
	W 15B-0c-8	0.488	se	8.986	1.498	333	333	2992	499	333	333	2992	343
11	W 12C-6bw	0.060	sw	2.820	0.759	0	0	0	0	0	0	0	0
	W 15B-0c-6	0.488	sw	13.07	2.996	523	523	6834	1567	523	523	6834	1332
	W 12C-6bw	0.060	nw	2.820	0.759	333	209	588	158	333	209	588	132
	G 1D-c2ow	0.550	nw	25.85	34.40	83	0	2157	2871	83	0	2157	6231
	G 10B-w	0.600	nw	28.20	18.13	41	0	1156	743	41	0	1156	1482
	C 16B-28md	0.034	-	1.598	1.770	0	0	0	0	0	0	0	0
	F 22A-vpm	1.180	-	55.46	0.000	330	55	3050	0	330	55	3050	0
	F 21A-28t	0.022	-	1.034	0.000	1411	116	1459	0	1411	116	1459	0
Total room load								32493	9408			32493	12629
Air required (cfm)								467	467			467	627

Why is proper equipment sizing important?


- Equipment first-cost
- Longer/more efficient run times
- Limits equipment cycling
- Better dehumidification

HVAC Load Calculations

Section C403.1.1 (Mandatory)

Heating and cooling load sizing calculations required:


- ASHRAE/ACCA Standard 183
 - OR -
- Other approved computation procedures – defined in Chapter 3
 - Interior design conditions specified by Section C302
 - $\leq 72^{\circ}\text{F}$ for heating load
 - $\geq 75^{\circ}\text{F}$ for cooling load
- Loads reduced from energy recovery systems utilized in the HVAC system shall be accounted for in accordance with the ASHRAE HVAC Systems and Equipment Handbook



Ventilation

Section C403.2.2 (Mandatory)

- Natural and mechanical ventilation to be provided in accordance with Chapter 4 of the IMC
- If mechanical: system to provide the capability to reduce outdoor air supply to minimum required by IMC Chapter 4



Equipment and System Sizing

Section C403.3.1 (Mandatory)

- Output capacity of heating and cooling equipment only SHALL NOT be greater than calculated loads
- Select the system which serves the greater load – heating or cooling

Air Sealing, Testing & Ventilation | R402.4

- **2009 IECC** Requirement: 7 ACH50 (testing optional)
 - Mechanical Ventilation not required
- **2015 IECC** Requirement: 5 ACH50 (testing Required)
- **2018 IECC** Requirement: 3 ACH50 (testing required)
 - Mechanical ventilation required and is critical!
 - Exhaust, Supply or Balanced Ventilation
 - As simple as a continuous bath fan
- **2021 IECC** Requirement: 3 ACH50 (No Real Change)

Recessed Lighting

All recessed luminaires installed in the building thermal envelope must be IC rated and have the following:

- Sealed with gasket or caulk between housing and interior wall or ceiling covering
- Labeled in accordance with ASTM E 283 to allow ≤ 2.0 cfm of air movement between conditioned and unconditioned spaces



Ventilation and Air Sealing

- Both natural and mechanical ventilation provide fresh air that can dilute and remove indoor pollutant levels
- Per the IMC/IRC, mechanical ventilation is required when homes are <5 ACH 50
 - Need to do a blower door test to determine leakage rate
 - **Liability concerns when not performed**
- A blower door test measures a building's existing air leakage
- Can not design a code compliant system without knowing air leakage



Courtesy of AC Tool Supply, Inc.

Balanced Ventilation

- Blows air into and out of the house
- Is cost effective by reclaiming energy from exhaust and supply airflows (60%-80%!)
- Balances exhaust and supply flows (minimizes pressure differential)
- Maintains the Minimum Ventilation Guideline automatically with proper set-up

Ventilate cont.

- Tips and cautions:
 - Natural ventilation may be inadequate or excessive if the indoor environment's driving forces are inadequate.
 - Ventilating air can have a higher level of pollutant than the indoor air (e.g., moisture, pollen, smoke).
- The priority is to control ventilation:
 - Spot ventilation systems (supply-only and exhaust-only)
 - Balanced ventilation systems (heat recovery and energy recovery ventilators)

Spot Ventilation (Supply-only and Exhaust-only)

- Supply spot ventilation:
 - Whole house
 - Makeup air or combustion air for appliances
- Exhaust spot ventilation:
 - Bathroom exhaust fan
 - Range hood vent
 - Ducted garage fan
 - Central vacuum
- Fans or portals with humidity-sensitive nylon strips



Balanced Ventilation

- Blows air into and out of the house
- Is cost effective by reclaiming energy from exhaust and supply airflows (60%-80%!)
- Balances exhaust and supply flows
- Maintains the MVG automatically with proper set-up



Balanced Ventilation cont.



- A heat recovery ventilator (HRV) uses a heat exchanger to condition incoming fresh air:
 - It consists of a cube-shaped transfer unit made from special conductive materials.
 - Airflows pass through different sides of the cube (but are not mixed).
 - Conditioned exhaust air raises or lowers the incoming fresh air temperature.
 - Air passes through an HVAC air handler or directly to rooms.



Balanced Ventilation cont.

- An energy recovery ventilator (ERV) exchanges heat and moisture between the two air streams:
 - It transfers moisture by a desiccant wheel.
 - It allows the exchange of moisture to control humidity.
 - It preconditions the incoming flow with return air ducts before it exits.
 - It passes air through an HVAC air handler or directly to rooms.

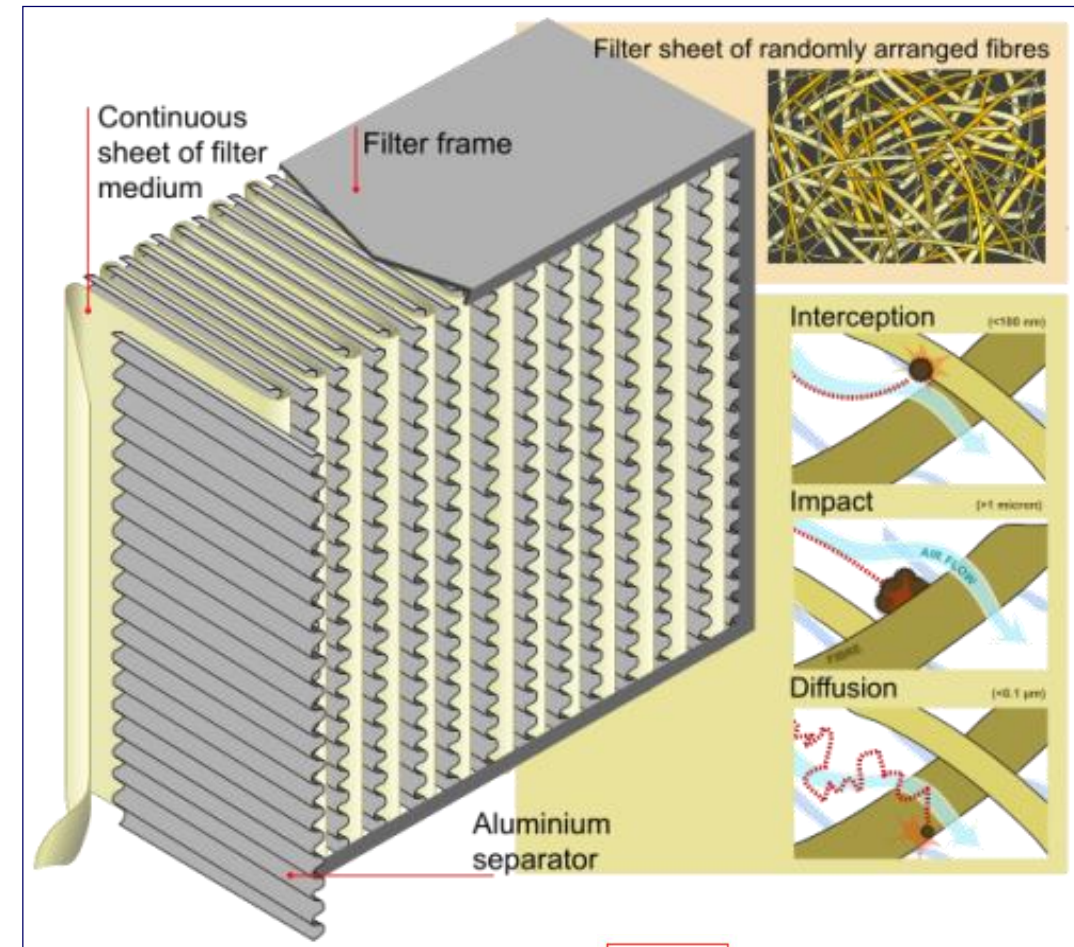


IAQ Issues?



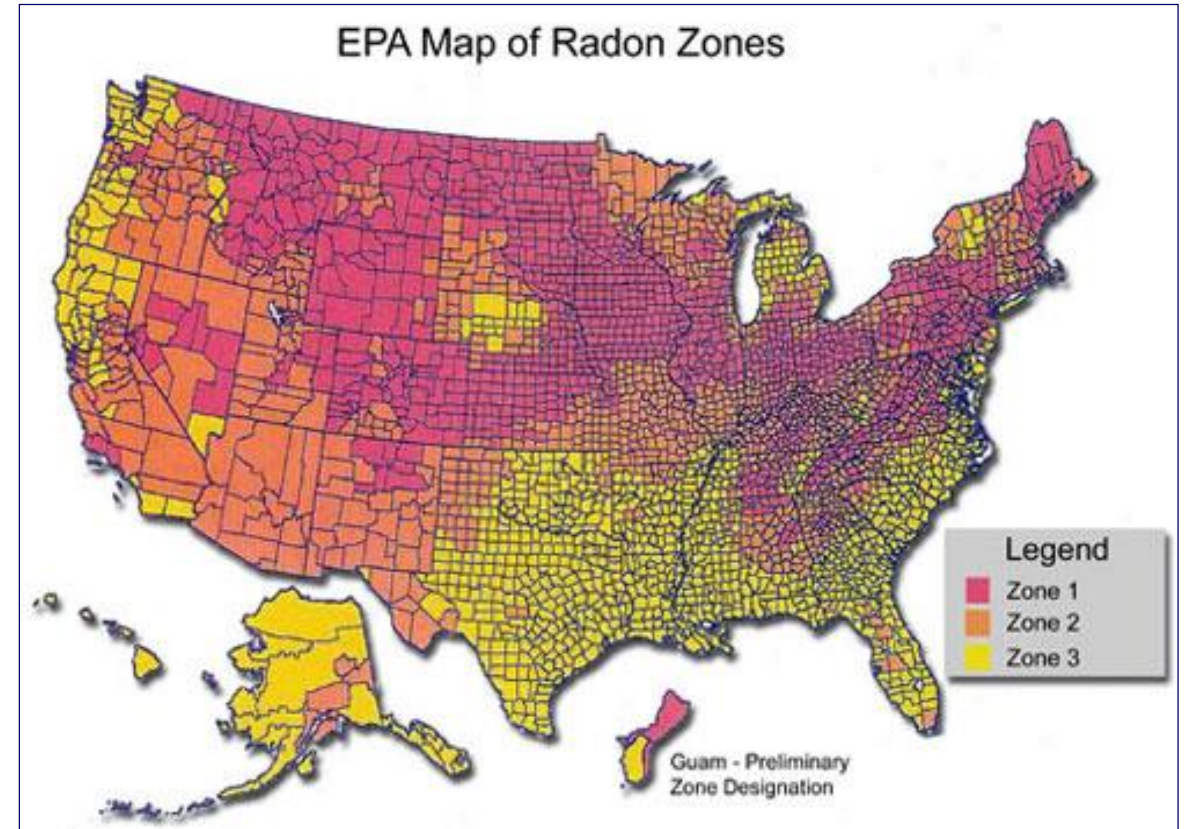
Filtrate Pollutants cont.

- HEPA filters:
 - Are 95 percent efficient
 - Are 99.97 percent effective:
 - Filter particles down to < 1 micron
 - Alter the particles' airflow streamlines
 - Vary in pressure drop characteristics
 - Are effective against bacteria and some viruses



Mitigate Radon

- High doses of radon may contribute to lung cancer.
- Construction methods can facilitate mitigation if radon is found to be a problem.
- The EPA's *Map of Radon Zones* assigns U.S. counties to zones.



Courtesy of U.S. Environmental Protection Agency

Zone	Level
1	> 4 pCi/L
2	2 to 4 pCi/L
3	2 pCi/L



Strategies for Mitigation

- The EPA has set forth model standards and techniques for control of radon in new residential buildings:
 - Design and construct to minimize the entrance of soil gas into the living space.
 - Design and construct to facilitate post-construction radon removal or further reduction of radon entry.



Radon Mitigation



Insulation and Fenestration | Table 402.1.2

Requirement	2009 IECC	2018 IECC
Fenestration U-factor	0.40	0.32
Glazed Fenestration	NR	0.40
Ceiling R-Value	R-30	R-40
Wall R-Value	R-13	R-20 or 13+5
Basement R-Value	R-13	R-13
Slab R-Value/Depth	10, 2ft	10, 2ft (R-5 under heated slab)
Crawl Space R-Value	R-5	R- 10/13



Biggest Changes in IECC 2021

- Redrawn Climate Zones (No Change in NE)
- Improved Window U-factors & Wall and Ceiling R-values
- Attic pull-down stairs – R-13 okay for CZ1-4
- Floor insulation – 3 options
- Basement option details
- Sunrooms and heated garage separation
- Ducts Testing on all systems
- Ducts inside, < 8% Total Leakage
- Ducts outside, < 4% Total Leakage
- Verified fan (kitchen, bath, whole house) airflow
- All efficient lighting and controls (100%)
- Must choose your Additional Efficiency Package



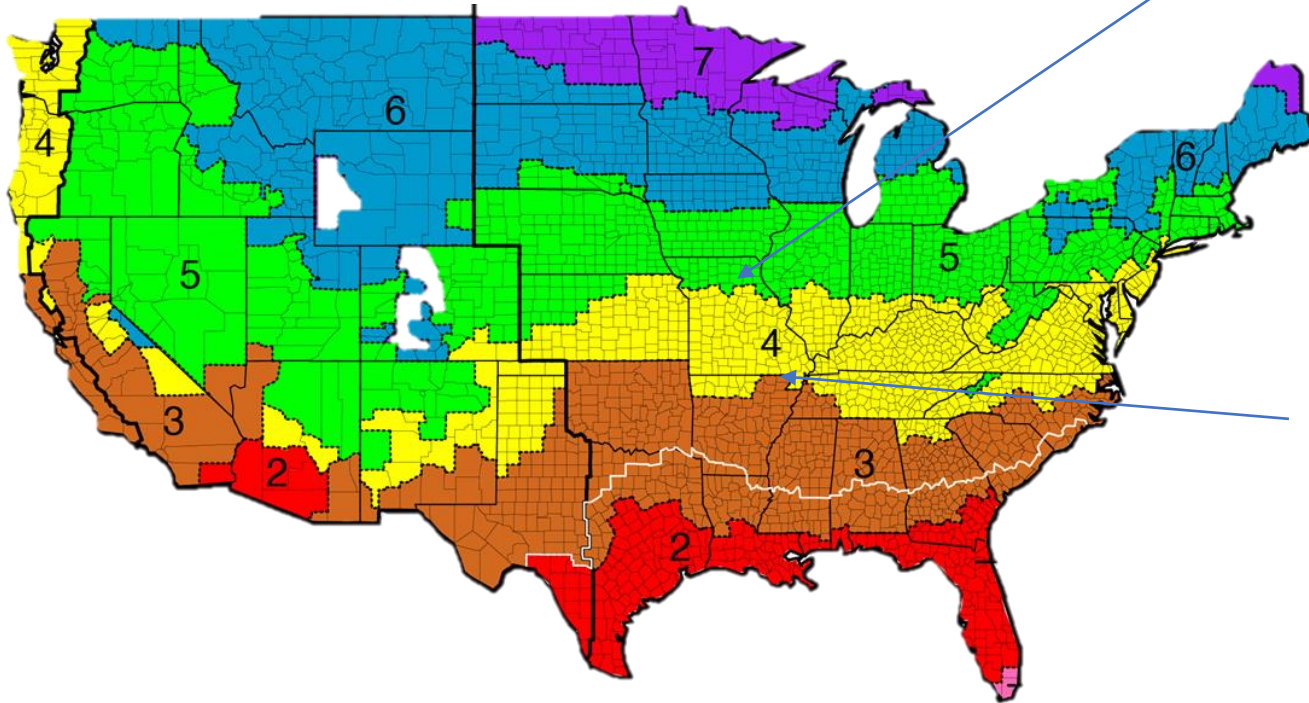
Changes in IECC 2021

- **Definitions Added/Modified:**
 - *Lighting Definition Modification*
 - Information Technology Equipment (ITE)
 - Internal Curtain System
 - *On-Site Renewable Energy*
 - *Renewable Energy Resources*
 - *Testing Unit Enclosure Area*
 - *Thermal Distribution Efficiency (TDE)*
 - *Vegetative Roof*
 - *Visible Transmittance*



Climate Zones '21

- Buchanan, Caldwell, Chariton, Clinton, are now CZ 4A (Mo)



- Dunklin & Pemiscot, are now CZ 3A (Mo)

2021 IECC

One prescriptive “answer” for how to build per climate zone
(now CZ: 3, 4, 5)

- Buchanon, Caldwell, Chariton, Clinton, are now CZ 4A
- Dunklin & Pemiscot, are now CZ 3A



TABLE R402.1.3 INSULATION MINIMUM R-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT³

CLIMATE ZONE	FENESTRATION U-FACTOR ^{b, i}	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b, e}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE ^g	MASS WALL R-VALUE ^h	FLOOR R-VALUE	BASEMENT ^{c, g} WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE ^{c, g} WALL R-VALUE
3	0.30	0.55	0.25	49	20 or 13& 5ci ^h or 0& 15ci ^h	8/13	19	5ci or 13 ^f	10ci, 2 ft	5ci or 13 ^f
4 except Marine	0.30	0.55	0.40	60	30 or 20&5ci ^h or 13& 10ci ^h or 0&20ci ^h	8/13	19	10ci or 13	10ci, 4 ft	10ci or 13
5 and Marine 4	0.30 ^j	0.55	0.40	60	30 or 20&5ci ^h or 13& 10ci ^h or 0&20ci ^h	13/17	30	15ci or 19 or 13& 5ci	10ci, 4 ft	15ci or 19 or 13& 5ci
6	0.30 ^j	0.55	NR	60	30 or 20&5ci ^h or 13& 10ci ^h or 0&20ci ^h	15/20	30	15ci or 19 or 13& 5ci	10ci, 4 ft	15ci or 19 or 13& 5ci

402.1.2 is similar table for U-factors (get U-values from RESCheck)

Insulation Requirements

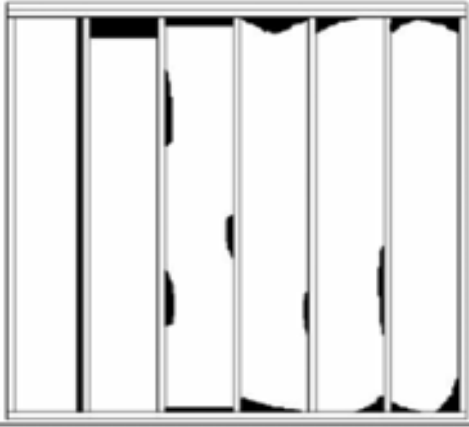
- **402.2.1 - Ceilings with Attics**
- R-49 (CZ3) and R-60 (CZ4-5)
- is prescriptive requirement
- Rulers required every 300 s.f.



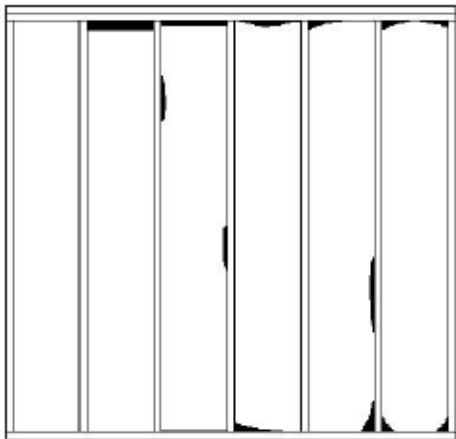
Insulation Installation: Grade I, II, or III

- Unless verified, assume Grade III (worst) – see RESNET Appendix A-11-16

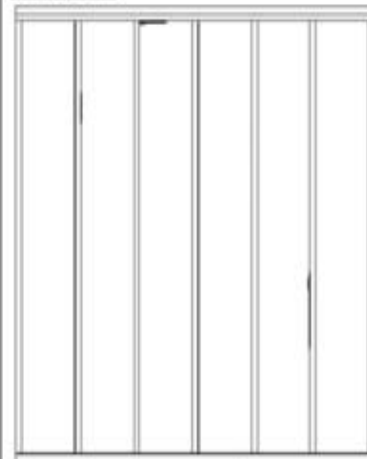
installation shall be *at least* this good to be labeled as "Grade III":



"Grade II":



"Grade I":



No more than 2% of surface area of insulation missing is acceptable for "Grade II"

Occasional very small gaps are acceptable for "Grade I".

High Performance Top Ten List

- 1. Pay Attention to the Sun
- 2. Ductwork
- 3. Thermal Package
- 4. Equipment
- 5. Bulk Moisture & Cladding
- 6. Humidity Control
- 7. Indoor Air Quality
- 8. Appropriate Ventilation
- 9. Lighting and Plug Loads
- 10. Production for Zero Energy



Use Tools and Technology to help us!



Design Approach for a High-Performance Home

- • **Building Science as guide**
- Understand physics of heat air and moisture flow
- • **High Performance Enclosure**
- Sound structure, shell is tight, well-insulated and resilient
- • **Air Distribution**
- Sealed & insulated ducts – located inside building envelope, intentional fresh air delivery
- • **Reduced Equipment & Loads**
- Efficient Heating, Cooling, Hot Water, Lights, Appliances



The Key: It's not necessarily the stuff in the building — it's how it's all put together! (The house is a system)

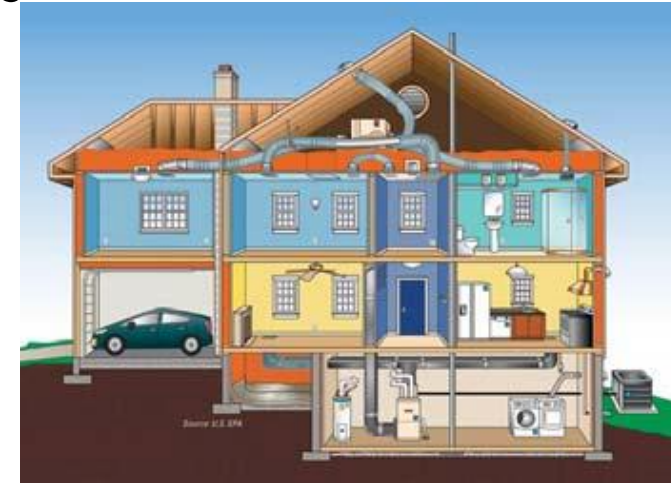
Building Thermal Envelope

A well-designed building envelope promotes energy conservation through proper placement and appropriate use of materials for effective:

- Air barrier
- Insulation
- Moisture control
- Windows, doors and skylights

IECC Definition;

The basement walls, exterior walls, floor, roof and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.



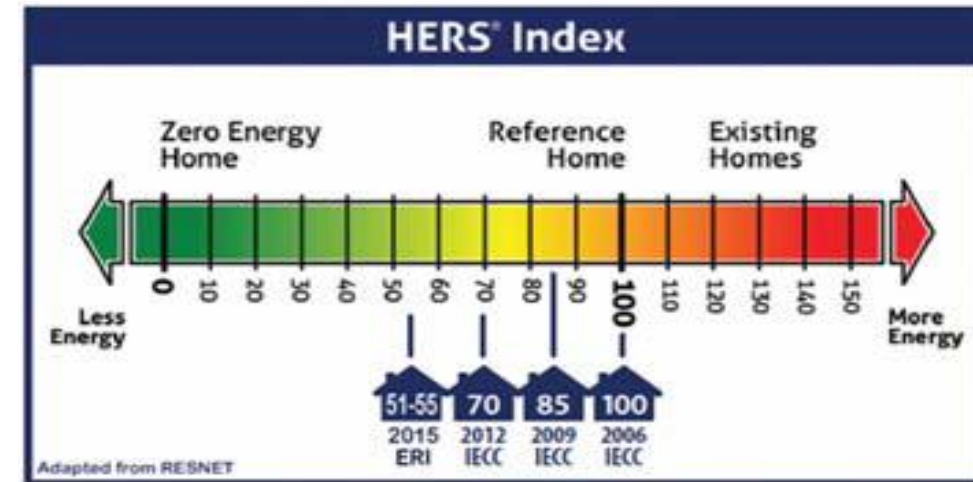
Envelope Tradeoff Options:

- REScheck Tradeoff Option
- Simulated Performance Alternative
- Energy Rating Index (ERI) path



HERS / Energy Rating Index – What does it mean?

- HERS Index (lower is better)
- Rated home with Index of 100 = Reference home exactly meeting 2004/06 IECC
- Net Zero Energy Home = HERS Index of 0



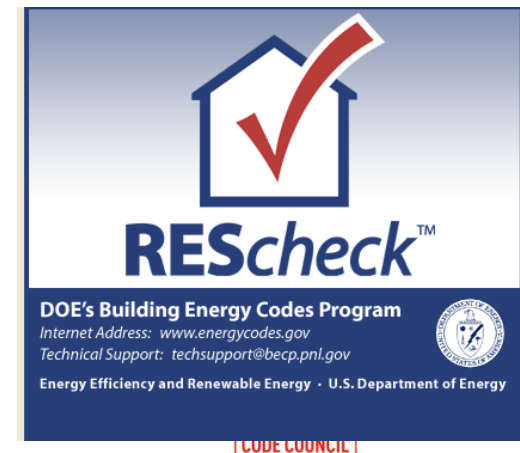
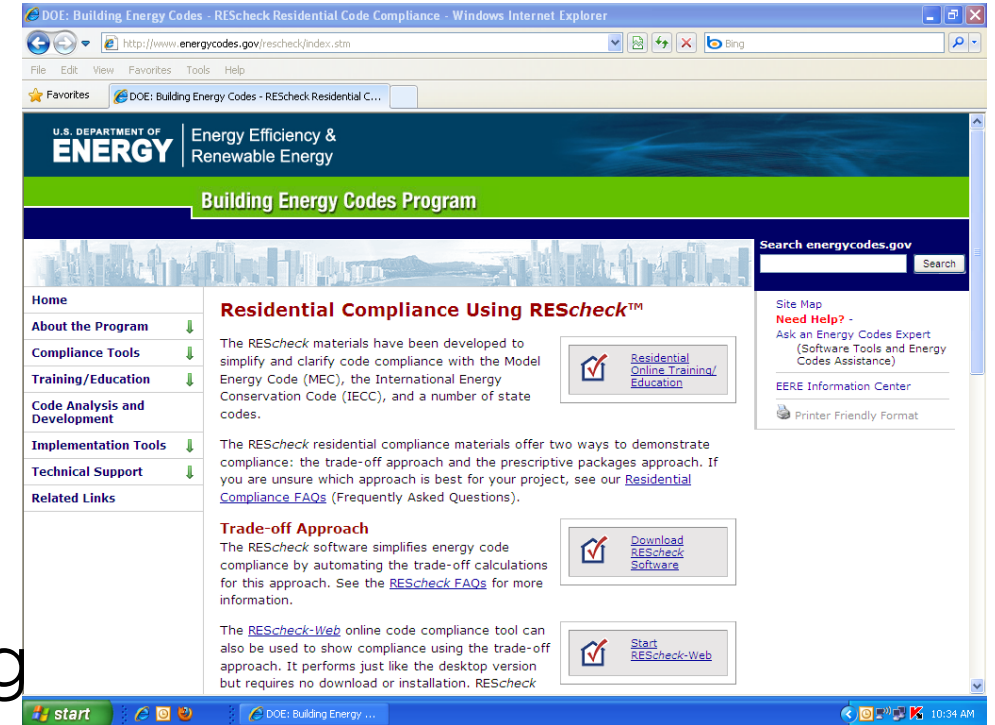
REScheck Tradeoff Option

- www.energycodes.gov
- Software evaluates specific designs quickly
- Demonstrates SHGC compliance
- Allows trade-offs
- Building envelope components

REScheck Tradeoff Option

www.energycodes.gov

- Software evaluates specific designs quickly
- Demonstrates SHGC compliance
- Allows trade-offs
- Building envelope components
- No trade-offs for better heating & cooling equipment efficiencies
- Specify code edition
- UA or Simulated Performance



Section 405 Simulated Performance Alternative - Sample Report

- Annual energy usage
- simulation demonstrates that the proposed building's energy costs are < "standard code" building
- No credit for mechanical efficiencies
- Likely to involve a HERS rater
- Ekotrope, REMrate & Energy Gauge are acceptable

Compares energy costs of actual home being built against IECC reference home's energy cost

- Window U-factor and SHGC
- Envelope and duct Testing
- Lighting, duct insulation

IECC 2015 Performance Compliance

Property 123 Fake Street Savannah, GA 31302	Organization Southface Training Southface Trainer	Inspection Status Results are projected
Improved to pass 2015 IECC ACME ACME2 - MB	Builder Wilry E Coyote	

Design	Annual Energy Cost	
	IECC 2015 Performance	As Designed
Heating	\$1,211	\$695
Cooling	\$414	\$387
Water Heating	\$372	\$371
Sub Total - Used to determine compliance	\$1,997	\$1,452
Lights & Appliances	\$806	\$806
Onsite generation	\$0	\$0
Total	\$2,803	\$2,259

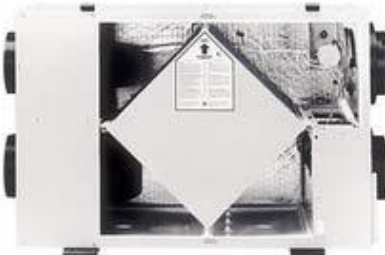
Requirements

<input checked="" type="checkbox"/>	405.3	Performance-based compliance passes by 27.2%
<input checked="" type="checkbox"/>	402.4.1.2	Air Leakage Testing <small>Air sealing is 5.00 ACH@ 50 Pa. It must not exceed 5.00 ACH@ 50 Pa.</small>
<input checked="" type="checkbox"/>	402.5	Area-weighted average fenestration SHGC
<input checked="" type="checkbox"/>	402.5	Area-weighted average fenestration U-Factor
<input checked="" type="checkbox"/>	404	Lighting Equipment Efficiency
<input checked="" type="checkbox"/>	R403.6.1	Mechanical Ventilation Efficacy
<input checked="" type="checkbox"/>	Mandatory Checklist	Mandatory code requirements that are not checked by Ekotrope must be met.
<input checked="" type="checkbox"/>	R405.2	Duct Insulation

Design exceeds requirements for IECC 2015 Performance compliance by 27.2%.

Energy Rating Index (ERI) path

- The ERI may allow more options in materials choice, technologies and innovative strategies than the simulated performance path



- The Energy Rating Index (ERI) path gives the most design flexibility (e.g., credit for mechanical equipment efficiency)
- It also credits items not covered by the code (e.g., appliance efficiencies)

Determining the Energy Rating Index

1. Simulate two homes
 - **Rated** Home – what will be built
 - **Reference** Home – same home but exactly meets '06 code
2. Compare Annual Energy
 - Space Heating & Cooling, Hot Water, Lighting and some Appliances
 - Multiply by 100 (lower w/ renewables)



Total UA Method

- All **mandatory and prescriptive** requirements (other than Table R402.1.2) must be met
- Include documentation to demonstrate compliance with the UA Trade-off method. Compliance software submittal must include completed compliance form, inspection checklist and certificate demonstrating compliance with 2018 IECC levels



Total wall performance allows for window walls or other design trade offs..



Blower Door Test

- Required in 2012/2015/2018 IECC
- Verifies Air Leakage / Tightness of a Building; pressurize or depressurize building using blower door fan
- Only indicates how leaky the building is, not necessarily where the leaks are
- Best to perform at rough-in, before drywall is installed; easier to correct leakage at this time
- Should be administered by a Certified Professional (e.g., DET Verifier, BPI, HERS)



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Great Liability Protection for
Builder/Designer!



Quality Management

You don't get what you expect, You get what you inspect!



Checklists:

➤ Eliminates the gap between Potential and Application

➤ Identifies the “known unknowns” ahead of time so they can be dealt with!

They Provide:

✓ Guidance

✓ Compliance with schedule

✓ Documentation of critical items after cover.

✓ Liability Protection

ENERGY STAR Single-Family New Homes
Quality Assurance & Certification Review Checklists,
Version 3 / 3.1 (Rev. 11)



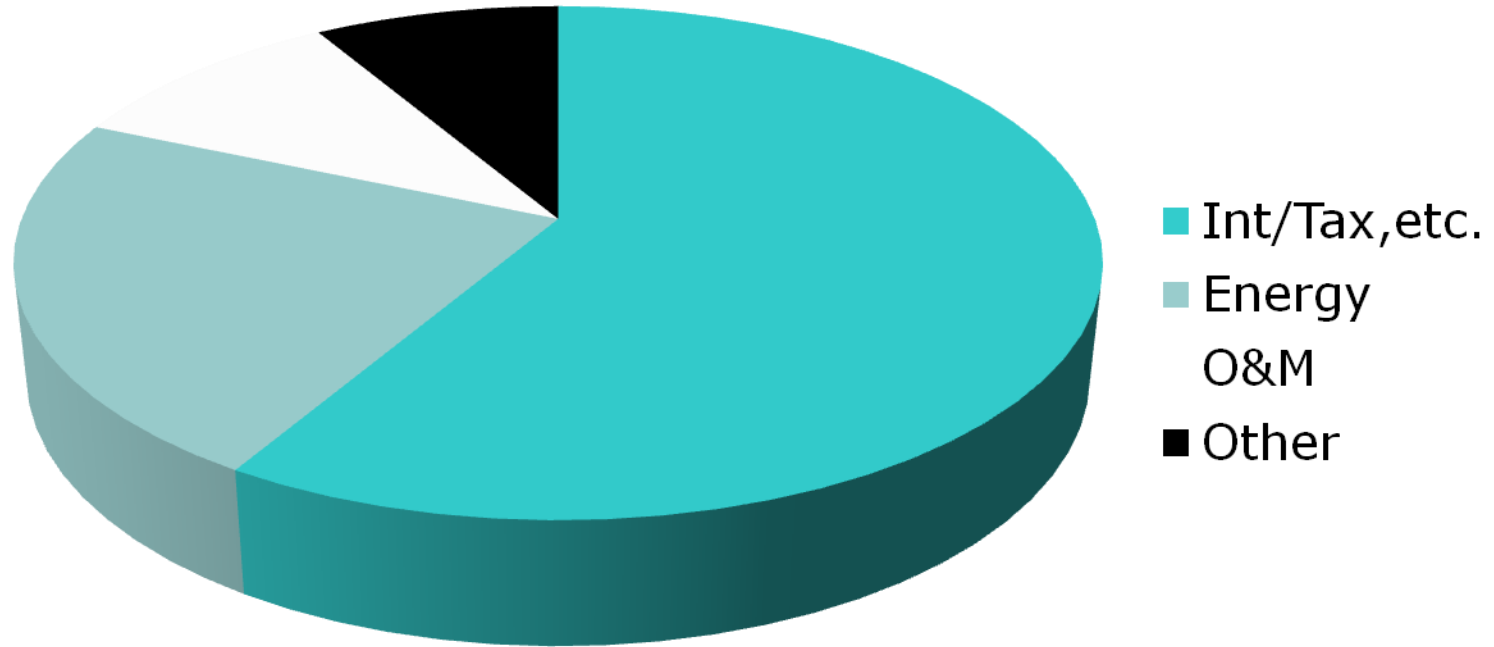
APPROVED B-17F and G CHECKLIST
REVISED 3-1-44

PILOT'S DUTIES IN RED
COPILOT'S DUTIES IN BLACK

<p>BEFORE STARTING</p> <ol style="list-style-type: none">1. Pilot's Preflight—COMPLETE2. Form 1A—CHECKED3. Controls and Seats—CHECKED4. Fuel Transfer Valves & Switch—OFF5. Intercoolers—Cold6. Gyros—UNCAGED7. Fuel Shut-off Switches—OPEN8. Gear Switch—NEUTRAL9. Cowl Flaps—Open Right—OPEN LEFT—Locked10. Turbos—OFF11. Idle cut-off—CHECKED12. Throttles—CLOSED13. High RPM—CHECKED14. Autopilot—OFF15. De-icers and Anti-icers, Wing and Prop—OFF16. Cabin Heat—OFF17. Generators—OFF <p>STARTING ENGINES</p> <ol style="list-style-type: none">1. Fire Guard and Call Clear—LEFT Right2. Master Switch—ON3. Battery switches and inverters—ON & CHECKED4. Parking Brakes—Hydraulic Check—On—CHECKED5. Booster Pumps—Pressure—ON & CHECKED6. Carburetor Filters—Open7. Fuel Quantity—Gallons per tank8. Start Engines: both magnetos on after one revolution9. Flight Indicator & Vacuum Pressures CHECKED10. Radio—On11. Check Instruments—CHECKED12. Crew Report13. Radio Call & Altimeter—SET	<p>ENGINE RUN-UP</p> <ol style="list-style-type: none">1. Brakes—Locked2. Trim Tabs—SET3. Exercise Turbos and Props4. Check Generators—CHECKED & OFF5. Run up Engines <p>BEFORE TAKEOFF</p> <ol style="list-style-type: none">1. Tailwheel—Locked2. Gyro—Set3. Generators—ON <p>AFTER TAKEOFF</p> <ol style="list-style-type: none">1. Wheel—PILOT'S SIGNAL2. Power Reduction3. Cowl Flaps4. Wheel Check—OK right—OK LEFT <p>BEFORE LANDING</p> <ol style="list-style-type: none">1. Radio Call, Altimeter—SET2. Crew Positions—OK3. Autopilot—OFF4. Booster Pumps—On5. Mixture Controls—AUTO-RICH6. Intercooler—Set7. Carburetor Filters—Open8. Wing De-icers—Off9. Landing Gear<ol style="list-style-type: none">a. Visual—Down Right—DOWN LEFT Tailwheel Down, Antenna in, Ball Turret Checkedb. Light—OKc. Switch Off—Neutral10. Hydraulic Pressure—OK Valve closed11. RPM 2100—Set12. Turbos—Set13. Flaps $\frac{1}{2}$—$\frac{1}{2}$ Down <p>FINAL APPROACH</p> <ol style="list-style-type: none">14. Flaps—PILOT'S SIGNAL15. RPM 2200—PILOT'S SIGNAL
--	--

Equity!

Cost



Monthly Payment



Lender Specification

- *“This Building is being built/renovated/updated to standards above prevailing code. It is designed and constructed with unique features and materials and with high efficient equipment and in accordance with high efficiency standards. The Lender shall choose an Appraiser educated and knowledgeable in this type of valuation of these specialized Buildings. It is understood that unless said Appraiser can provide verification of education and knowledge, they will not be permitted to conduct the appraisal for this project.”*



Bottom Line = Bottom Line

- “Right Sized” better design
- Comfort
- Competitively Priced
- Energy Savings + Reduced Maintenance

Cash Savings = Equity



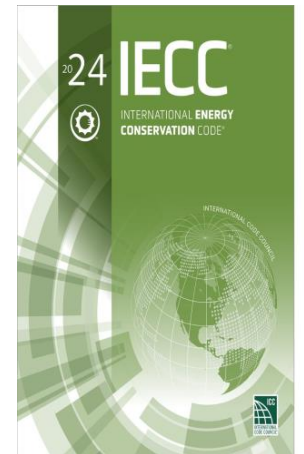
Looking Ahead:



- IECC changes to The National Energy Standard as of 2024.
- Uses 2021 IECC as a baseline.
- Introduces Carbon Impact into the conversation.
- On a trajectory for Net Zero Energy as of 2030.

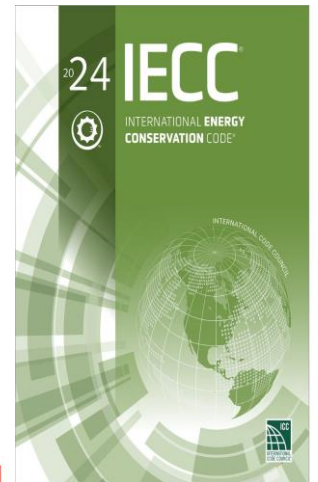
2024 National Energy Standard

- In Process since November '21
- Use '21 Energy Code as Basis and Improvements from there.
- Many more stakeholders than IECC Development
- Glide slope to Net Zero by 2030
- Expanded Appendices
- Carbon Impact/Credits



2024 National Energy Standard (Cont.)

- More focus on Electrification
- Tables for Envelope and Fenestrations (402/403) updated
- More reliance of high performance
- More focus on testing/verification
- More intent to move appendices items forward in 2027 & 2030 versions





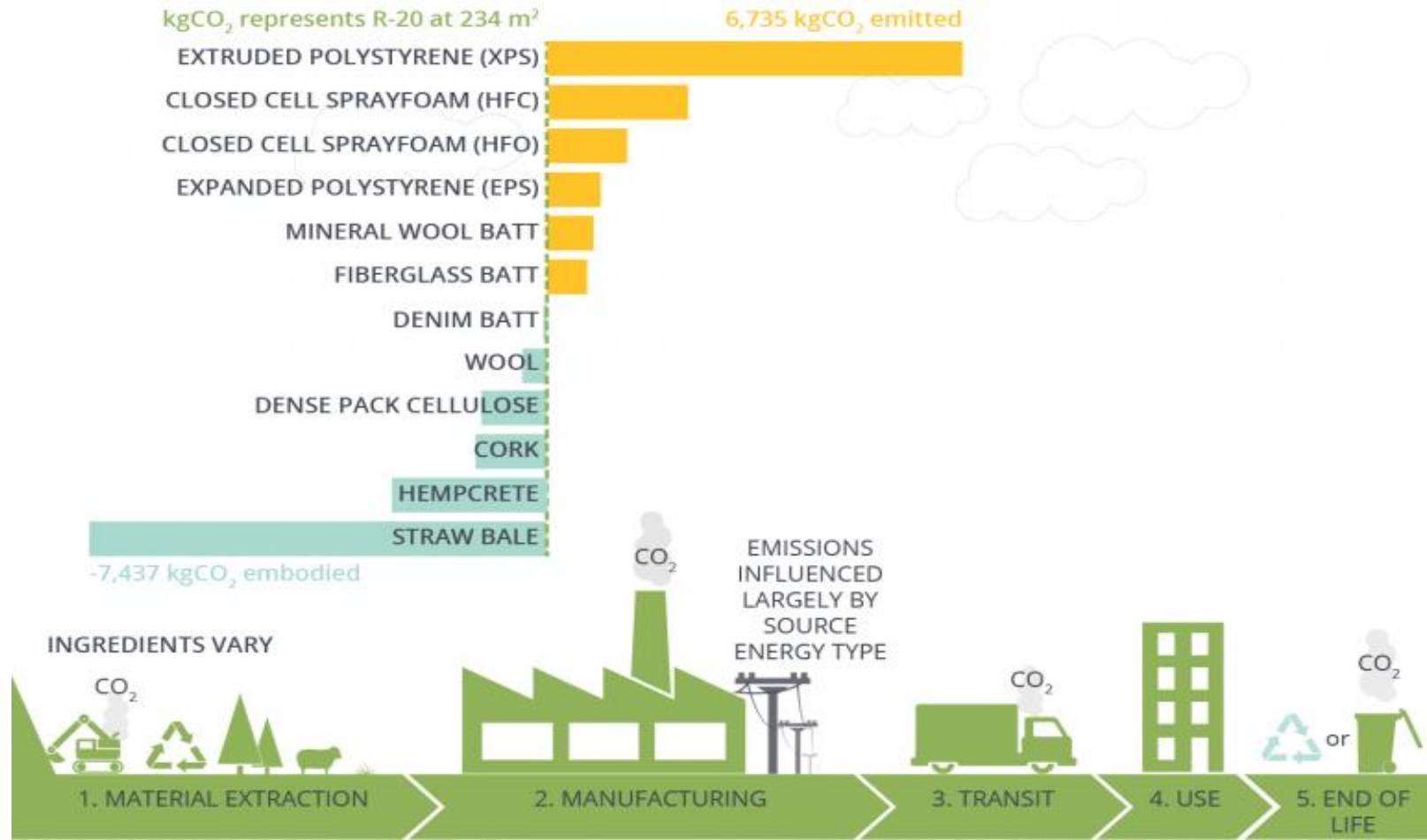
Carbon

What is a carbon credit?

- A carbon credit represents one unit of greenhouse gas (GHG) emissions reduced or carbon dioxide removed from the atmosphere.
- Carbon credits can be used to offset emissions.

Carbon

CARBON IMPACTS OF INSULATION



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Carbon impacts data source: Builders for Climate Action - 2019 White Paper "Low-Rise Buildings as a Climate Change Solution", Chris Magwood, 2019;

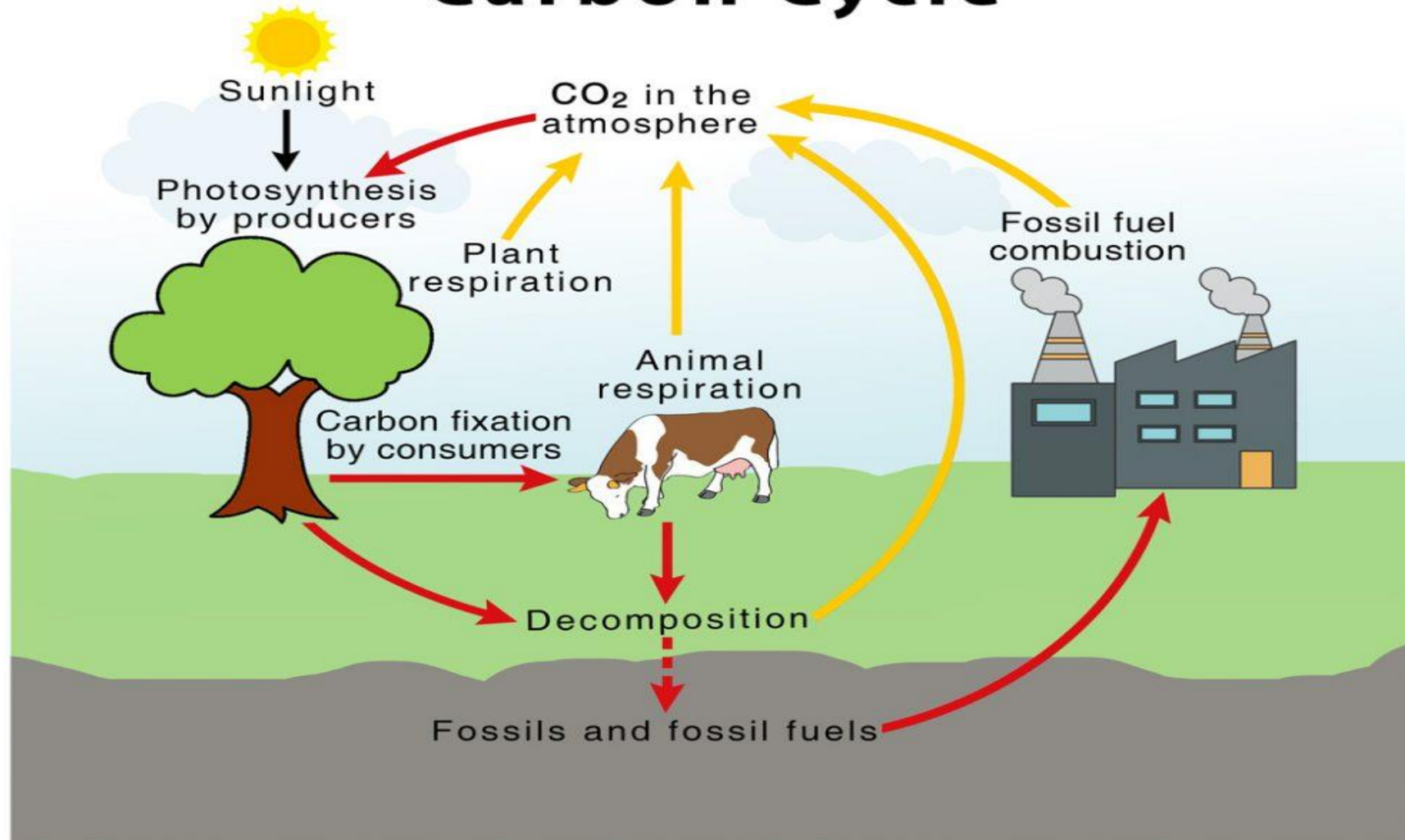
Carbon Reduction



Carbon Capture



Carbon Cycle



ScienceFacts.net



2024 Energy Standard

- Many of these “advanced” technologies and practices have actually been in use for a number of years.
- As newer technologies and components come along, they are easier to incorporate
- They all require the “basics” to be done properly!
- They are all systems part of a larger system!

Key Takeaways

- 2018/2021 IECC has new requirements for:
 - Air sealing
 - Duct sealing
 - U-Factor
 - R-Values
 - Performance Testing
- Controlling moisture is critical
 - Proper air sealing is key
 - Right-sizing HVAC is required
 - Mechanical ventilation must be installed and takes on new importance



Key Takeaways

- 2024 Energy Standard has new requirements for:
 - Electrification
 - EV Charging
 - Solar
 - Grid Interaction
 - Carbon
- Using & Understanding Guides and formulas is *critical*
 - Good Design!!!
 - Proper envelope construction is key
 - Right-sizing HVAC is required
 - Documenting construction and certification



Key Takeaways

- Many of these “advanced” technologies and practices have actually been in use for a number of years.
- As newer technologies and components come along, they are easier to incorporate
- They all require the “basics” to be done properly!
- They are all systems part of a larger system!



Upcoming Events

December 13, 11am – 12:30pm – Training on Multifamily Buildings and Mixed-Use, IECC and ASHRAE

Winter 2024 - Online MCC Energy Code Certificate 4-Week Course: Foundations for Residential and Commercial Energy Code Compliance in Nebraska





Thank you!

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