Nebraska Energy Code: 2018, 2021, and 2024 IECC Overview

Nebraska Energy Code Training Program

Instructor: Matt Belcher

December 12, 2024

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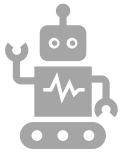
Housekeeping

Attendees are muted upon entry

Questions? Enter them in the chat box, or simply unmute yourself and ask

Webinar is being recorded – slides and recording will be sent to attendees



CEUs will be available upon request (ICC and AIA)

For questions about the program or CEUs contact John Gossman, jgossman@mwalliance.org

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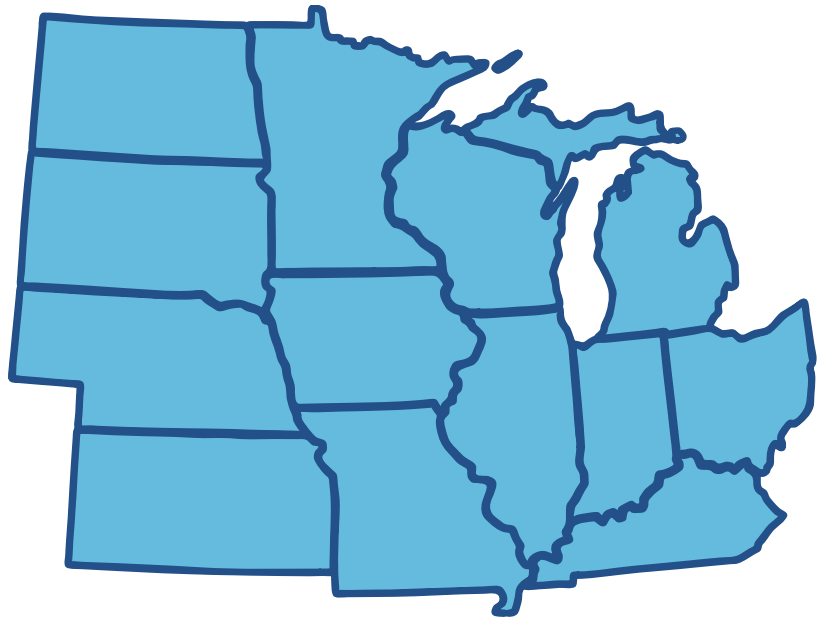
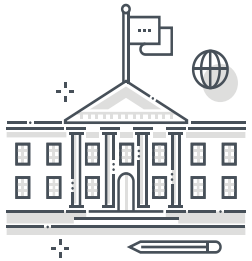
Who We Are

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 170+ members, including:

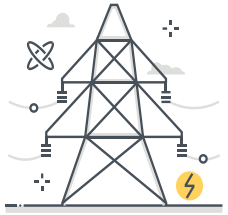


Energy Service Companies & Contractors



State & Local Governments

Academic & Research Institutions



Electric & Gas Utilities

Community-based Organizations

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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

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About Matt/Verdatek Solutions

- Builder & MEEA Circuit Rider MO & NE
-40+ Years in the Building Industry
- Served as a Top Building Codes official in the St. Louis area.
-Director of University of Missouri Columbia High Performance Buildings Research Center. Created and Instructed Curriculum for Students and Industry Professionals.
  - Currently Assisting University of Missouri Science & Technology in Building and Energy Code Curriculum and Policy.
  - Board of Advisors for Missouri Technical School, Construction & Workforce Development.
-ICC Member serving on 2012, 2015, 2018 and 2024 Energy (& Green) Code Development Committees. 2021& 27 Building Code-General Committee.
- NAHB Approved Instructor for Advanced Building Science, Advanced Business Management

All about the 2018, 2021, and 2024 IECC Learning Objectives

This interactive training will provide an overview of updates from the 2018 IECC to the 2021 IECC and a look beyond 2024 IECC.

-Residential and Commercial Basics

In this course you will:

1. Learn about the basic requirements of the 2018 IECC
2. Learn about the major changes to the 2021 IECC
3. Understand the 2024 IECC requirements
4. Understand the changes between the 2018 IECC and later versions of the energy code and how that will affect Building in Nebraska

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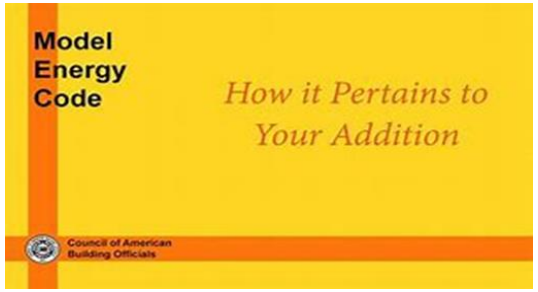
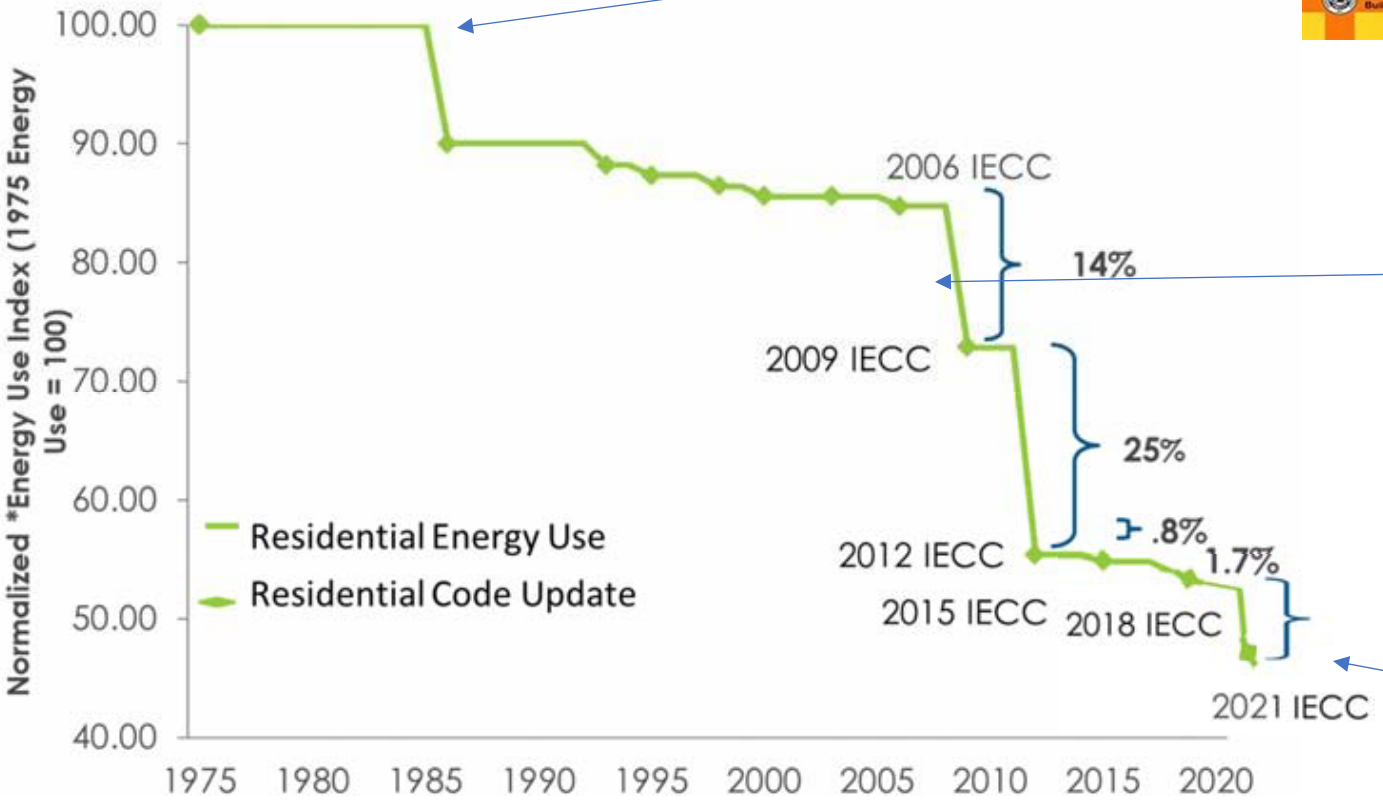
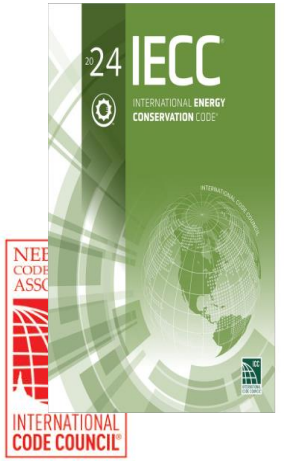
Residential Energy Code Background







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Biggest Changes in IECC 2021

- Redrawn Climate Zones (Nebraska Unchanged)
- Improved Window U-factors & Wall and Ceiling R-values
- 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
- Must choose your Additional Efficiency Package

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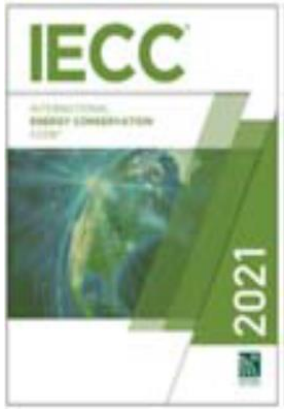
C401



Thermal Envelope Certificate Required

- Completed by an *Approved Party*
- Posted on a wall in the space where space conditioning equipment is located
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In Addition:

- Updates to Greenhouse Requirements.
- More Insulation Installation requirements.

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2021 IECC / IRC Section 11

Basics:

- Updated +/- 3% above 2018 IECC
- Testing and verification.
- Continues to Promote Innovation through Criteria: Energy Ratings Index (ERI) and 3 other alternative methods
- Biggest Changes:
  - -R 60 attic Insulation
  - -More focus on future electrification

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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.

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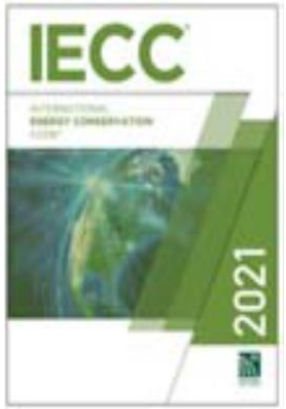
IECC 2021

Changes in IECC 2021



- **Definitions Added/Modified:**

- BioGas
- *Biomass*
- *Data Center/Computer Room*
- Direct Digital Control (DDC)
- Enthalpy Recovery Ratio
- Fans: Many Additions and Changes (Energy/Power, Number, etc.)
  - Large Diameter Fans
- Fault Detection and Diagnostics (FDD) System

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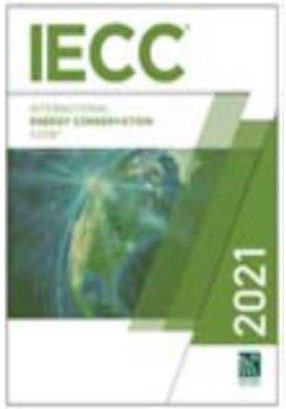

- **Definitions Added/Modified:**

- *Lighting Definition Modification*
- Information Technology Equipment (ITE)
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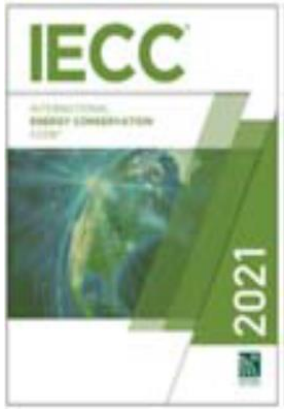

- **Administrative**
- C102: More Authority for Code Official to approve alternative material(s). (or not!)
- More definition for Code Officials Approval of Above Code Programs. (or not!)
- Information on Construction Documents must include: Energy Compliance Path and Air Sealing Details and Location of Air Barrier.

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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.*

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IECC 2021

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.

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IECC
2021

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.

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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.

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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 insulatio and corresponding R-values and protection and required controls. Where the solar-ready zone is installed for solar water heating, inspectior shall verify pathways for routing of plumbing from solar-ready zone to service water heating system.

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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 buildi types were exempted.

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IECC 2021

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.

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IECC 2021

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 ¾-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".

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IECC 2021

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.

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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.

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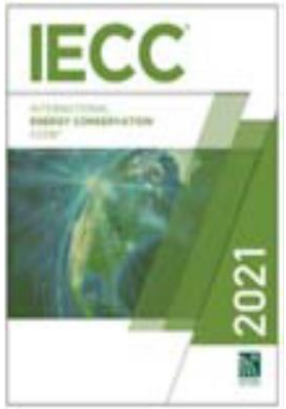
IECC 2021

Changes in IECC 2021



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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.

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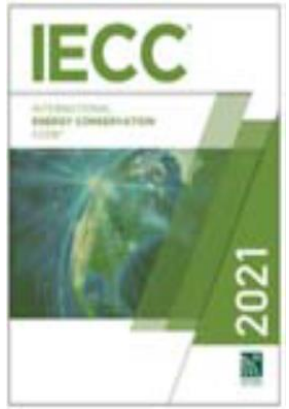
C401



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Compliance Options - Prescriptive

- Building must comply with
- C402 Envelope
- C403 Mech
- C404 SWH
- C405 Lighting
- Plus pick one additional efficiency package

TABLE C402.1.3 OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, *R*-VALUE METHOD[a]

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group
Roofs														
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-30ci	R-35ci	R-35ci
Metal buildings[b]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-60	R-60
Walls, above grade														
Mass[f]	R-5.7ci[c]	R-5.7ci[c]	R-5.7ci[c]	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci
Metal building	R-13 + R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-14ci	R-13 + R-17ci	R-13 + R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-10ci	R-13 + R-10ci	R-13 + R-12.5ci	R-13 + R-12.5ci	R-13 + R-12.5ci	R-13 + R-15.6ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R20 + R3.8ci	R-13 + R-7.5ci o R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci o R-20 + R-3.8ci
Walls, below grade														
Below-grade wall[d]	NR	NR	NR	NR	NR	NR	R-7.5ci	R-10ci	R-7.5ci	R-10ci	R-10ci	R-15ci	R-15ci	R-15ci
Floors														
Mass[e]	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-14.6ci	R-16.7ci	R-14.6ci	R-16.7ci	R-16.7ci	R-16.7ci	R-20.9ci	R-20.9ci
Joist/framing	R-13	R-13	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-38	R-38	R-38	R-38
Slab-on-grade floors														
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below	R-20 for 24" below	R-20 for 48" below	R-20 for 24" below	R- 48"
Heated slabs[g]	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below + R-5 full slab	R-7.5 for 12" below+ R-5 full slab	R-10 for 24" below + R-5 full slab	R-10 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 24" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-15 for 36" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R-20 for 48" below + R-5 full slab	R- 48" + R slab

TABLE C402.1.4 OPAQUE THERMAL ENVELOPE ASSEMBLY MAXIMUM REQUIREMENTS, *U*-FACTOR METHOD[a, b]

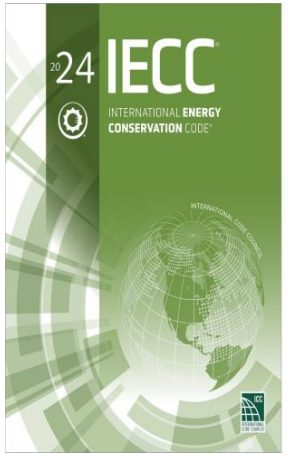
CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above roof deck	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.032	U-0.028	U-0.028	U-0.028	U-0.028
Metal buildings	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.029	U-0.029	U-0.029	U-0.026	U-0.026
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.017	U-0.017	U-0.017	U-0.017
Walls, above grade																
Mass[f]	U-0.151	U-0.151	U-0.151	U-0.123	U-0.123	U-0.104	U-0.104	U-0.090	U-0.090	U-0.080	U-0.080	U-0.071	U-0.071	U-0.071	U-0.037	U-0.037
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.050	U-0.050	U-0.050	U-0.050	U-0.050	U-0.044	U-0.039	U-0.039	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.055	U-0.055	U-0.049	U-0.049	U-0.049	U-0.042	U-0.037	U-0.037
Wood framed and other[c]	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.032	U-0.032
Walls, below grade																
Below-grade wall[c]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-1.140[e]	C-0.119	C-0.092	C-0.119	C-0.092	C-0.092	C-0.063	C-0.063	C-0.063	C-0.063	C-0.063
Floors																
Mass[d]	U-0.322[e]	U-0.322[e]	U-0.107	U-0.087	U-0.074	U-0.074	U-0.057	U-0.051	U-0.057	U-0.051	U-0.051	U-0.051	U-0.042	U-0.042	U-0.038	U-0.038
Joist/framing	U-0.066[e]	U-0.066[e]	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027
Slab-on-grade floors																
Unheated slabs	F-0.73[e]	F-0.73[e]	F-0.73[e]	F-0.73[e]	F-0.73[e]	F-0.54	F-0.52	F-0.52	F-0.52	F-0.51	F-0.51	F-0.434	F-0.51	F-0.434	F-0.434	F-0.424
Heated slabs	F-0.69	F-0.69	F-0.69	F-0.69	F-0.66	F-0.66	F-0.62	F-0.62	F-0.62	F-0.62	F-0.62	F-0.602	F-0.602	F-0.602	F-	02
Opaque doors																
Nonswinging door	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-	31
Swinging door[g]	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-	37
Garage door < 14% glazing[h]	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-0.31	U-	31

Additional Efficiency Package Options

- One additional efficiency feature must be selected to comply with the IECC
- C406.2 More efficient **HVAC** performance, OR
- C406.3 Reduced **lighting** power density system, OR
- C406.4 Enhanced lighting **controls**, OR
- C406.5 On-site supply of **renewable** energy
- C406.6 Dedicated outdoor air system (**DOAS**), OR
- C406.7 More efficient SWH (**hot water**) OR
- C406.8 Enhanced **envelope** performance OR
- C406.9 Reduced air **infiltration**

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



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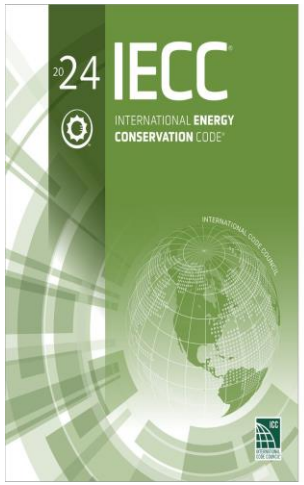
2024 National Energy Standard (Cont.)

- *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



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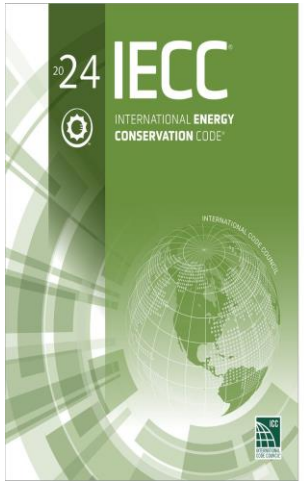
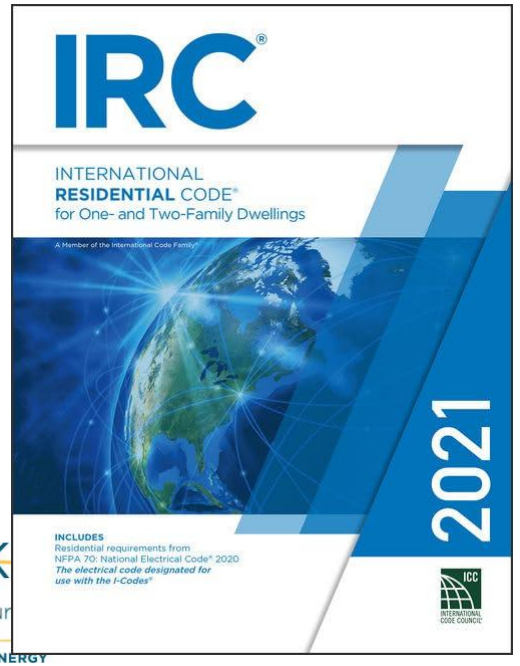
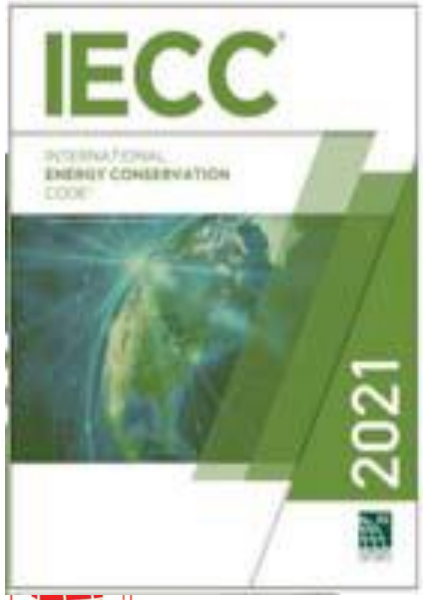
IECC and IBC

- Chapter 13 in the International Building Code (IBC). Chapter 11 (IRC) references the energy efficiency requirements found in the IECC

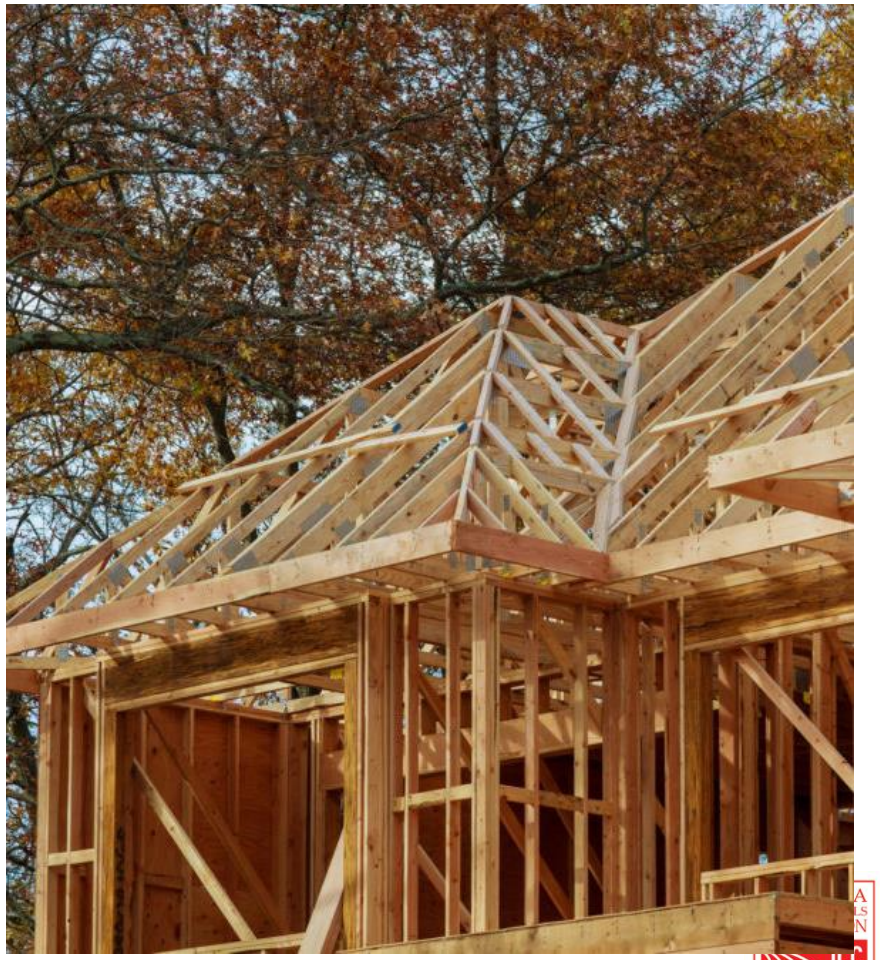






The Energy Code is Everywhere

- 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



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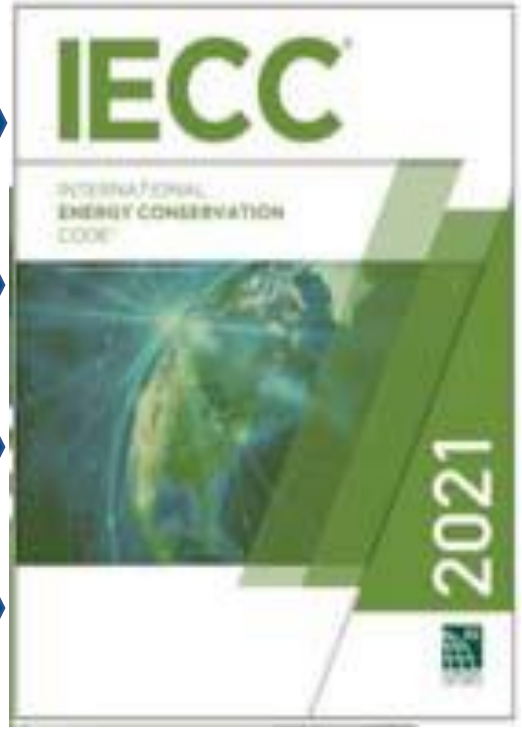
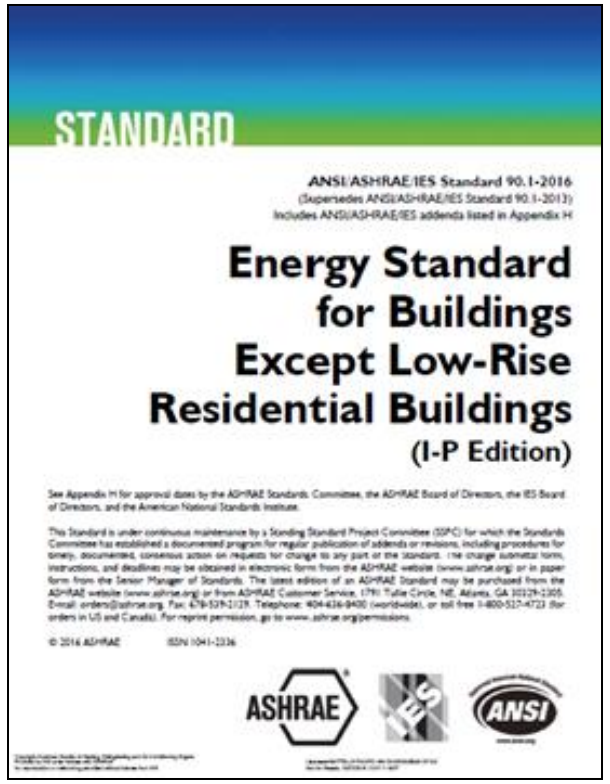
Two Commercial Compliance Options



We are going to discuss ASHRAE 90.1-2019 and its application with 2021 IECC**!**



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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.

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General Requirements

Section C402.1

Building thermal envelope to comply with the following:

- Specific insulation requirements of Section C402.2
- Thermal requirements of either:
  - R-value-based method of Section C402.1.3
  - U-, C-, and F-factor-based method of Section C402.1.4 **OR**
  - Component performance alternative of Section C402.1.5
- Fenestration in building envelope assemblies
- Air Leakage of building envelope assemblies

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Many Updates/Additions to Definitions

F-FACTOR (THERMAL TRANSMITTANCE). The perimeter heat loss factor for slab-on-grade floors (Btu/h × ft × °F) [W/(m × K)].

SUBSTANTIAL IMPROVEMENT. Any *repair*, reconstruction, rehabilitation, *alteration*, *addition* or other improvement of a *building* or structure, the cost of which equals or is more than 50 percent of the market value of the structure before the improvement. Where the structure has sustained substantial damage as defined in the ***International Building Code***, any repairs are considered *substantial improvement* regardless of the actual *repair* work performed. *Substantial improvement* does not include the following:

1. Improvement of a *building* ordered by the code official to correct health, sanitary or safety code violations.
2. *Alteration* of a historic building where the *alteration* will not affect the designation as a historic building.

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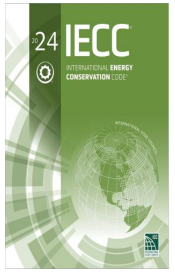

Compliance Options – Performance ('21)

- C407 Total Building Performance
- Building energy cost to be less than 85% of standard reference design building
- C402.5 Air Leakage
- C403.2 Provisions applicable to all mechanical
- C404 SWH
- Mandatory Lighting C405.2, C405.3, C405.4, C405.6

Envelope Tradeoff Options:

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

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Comcheck

Go to www.energycodes.gov and pull up COMCheck web

– establish a user's account & feel free to play with it

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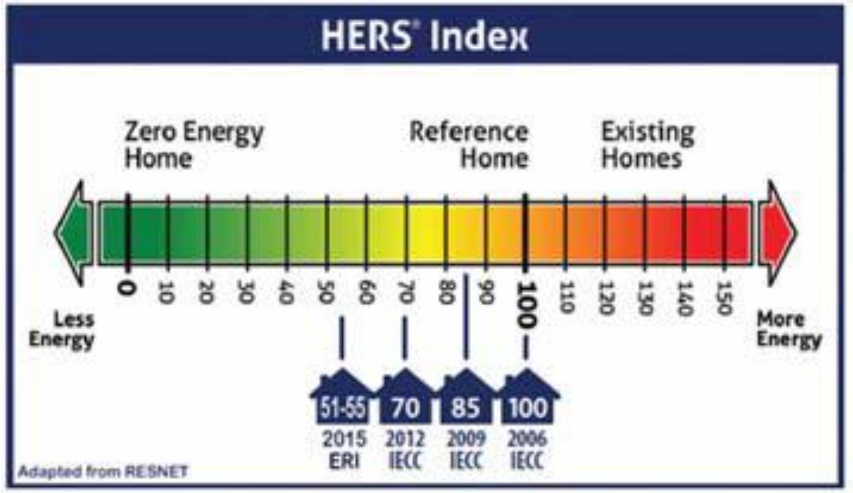
HERS / Energy Rating Index – What does it mean?

- 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 O



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**

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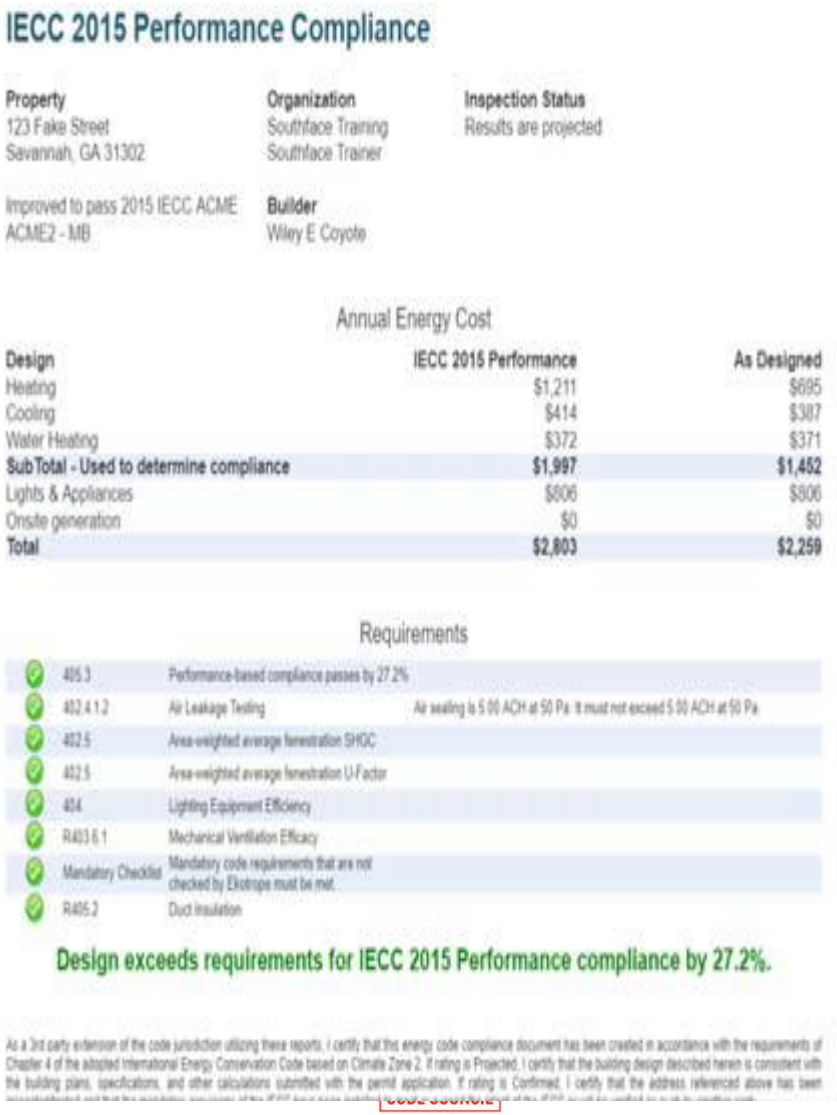
Section 405 Simulated Performance Alternative - Sample Report

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

Annual Energy Cost

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

Requirements

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

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

As a 3rd party extension of the code jurisdiction utilizing these reports, I certify that this energy code compliance document has been created in accordance with the requirements of Chapter 4 of the adopted International Energy Conservation Code based on Climate Zone 2. If rating is Projected, I certify that the building design described herein is consistent with the building plans, specifications, and other calculations submitted with the permit application. If rating is Confirmed, I certify that the address referenced above has been

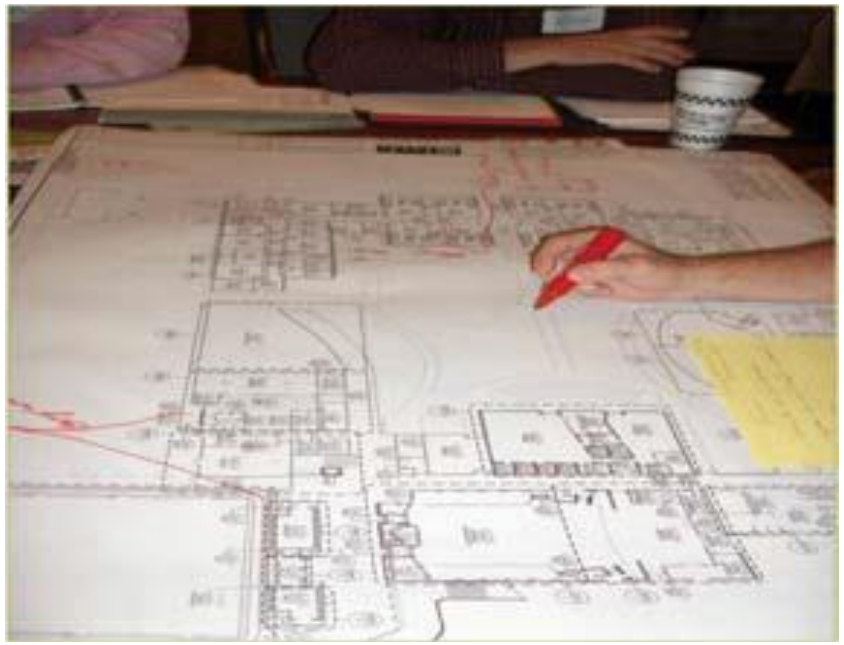
Determining the Energy Rating Index

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)



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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..

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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

IECC fenestration requirements

TABLE C402.4 BUILDING ENVELOPE FENESTRATION MAXIMUM *U*-FACTOR AND SHGC REQUIREMENTS

CLIMATE ZONE	0 AND 1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
Vertical fenestration																
U-factor																
Fixed fenestration	0.50		0.45		0.42		0.36		0.36		0.34		0.29		0.26	
Operable fenestration	0.62		0.60		0.54		0.45		0.45		0.42		0.36		0.32	
Entrance doors	0.83		0.77		0.68		0.63		0.63		0.63		0.63		0.63	
SHGC																
	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable	Fixed	Operable
PF < 0.2	0.23	0.21	0.25	0.23	0.25	0.23	0.36	0.33	0.38	0.33	0.38	0.34	0.40	0.36	0.40	0.36
0.2 ≤ PF < 0.5	0.28	0.25	0.30	0.28	0.30	0.28	0.43	0.40	0.46	0.40	0.46	0.41	0.48	0.43	0.48	0.43
PF ≥ 0.5	0.37	0.34	0.40	0.37	0.40	0.37	0.58	0.53	0.61	0.53	0.61	0.54	0.64	0.58	0.64	0.58
Skylights																
U-factor	0.70		0.65		0.55		0.50		0.50		0.50		0.44		0.41	
SHGC	0.30		0.30		0.30		0.40		0.40		0.40		NR		NR	

NR = No Requirement. PF = Projection Factor.

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.

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IECC 2021

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

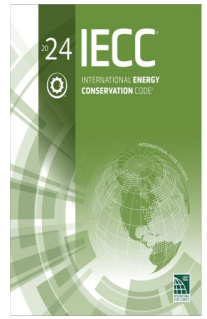
TABLE R402.1.3 INSULATION MINIMUM *R*-VALUES AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

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	.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	.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)

TABLE R402.1.2
MAXIMUM ASSEMBLY *U*-FACTORS[a] AND FENESTRATION REQUIREMENTS

CLIMATE ZONE	0	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7 AND 8
Vertical fenestration *U*-factor	0.50	0.50	0.40	0.30	0.30	0.28[d]	0.28[d]	0.27[d]
Skylight *U*-factor	0.60	0.60	0.60	0.53	0.53	0.50	0.50	0.50
Glazed vertical fenestration SHGC	0.25	0.25	0.25	0.25	0.40	NR	NR	NR
Skylight SHGC	0.28	0.28	0.28	0.28	0.40	NR	NR	NR
Ceiling *U*-factor	0.035	0.035	0.030	0.030	0.026	0.026	0.026	0.026
Insulation entirely above roof deck	0.039	0.039	0.039	0.039	0.032	0.032	0.032	0.028
Wood-framed wall *U*-factor	0.084	0.084	0.084	0.060	0.045	0.045	0.045	0.045
Mass wall *U*-factor[b]	0.197	0.197	0.165	0.098	0.098	0.082	0.060	0.057
Floor *U*-factor	0.064	0.064	0.064	0.047	0.047	0.033	0.033	0.028
Basement wall *U*-factor	0.360	0.360	0.360	0.091[c]	0.059	0.050	0.050	0.050
Unheated slab *F*-factor[e]	0.73	0.73	0.73	0.54	0.51	0.51	0.48	0.48
Heated slab *F*-factor[e]	0.74	0.74	0.74	0.66	0.66	0.66	0.66	0.66
Crawl space wall *U*-factor	0.477	0.477	0.477	0.136	0.065	0.055	0.055	0.055



Many Updates to Table R402.5.1.1 (replaces table R402.1.1)

101867597

~~TABLE R402.4.1.1~~TABLE R402.5.1.1
AIR BARRIER, AIR SEALING AND INSULATION INSTALLATION[a]

COMPONENT	AIR BARRIER, AIR SEALING CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous air barrier shall be installed in the building thermal envelope. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	~~The~~An air barrier shall be installed in any dropped ceiling or soffit to separate it from unconditioned space. ~~shall be aligned with the insulation and any gaps in the air barrier shall be sealed~~. Access openings, drop down	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier. Access hatches and doors shall be installed and insulated in accordance with **Section R402.2.5**.

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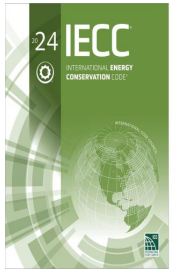
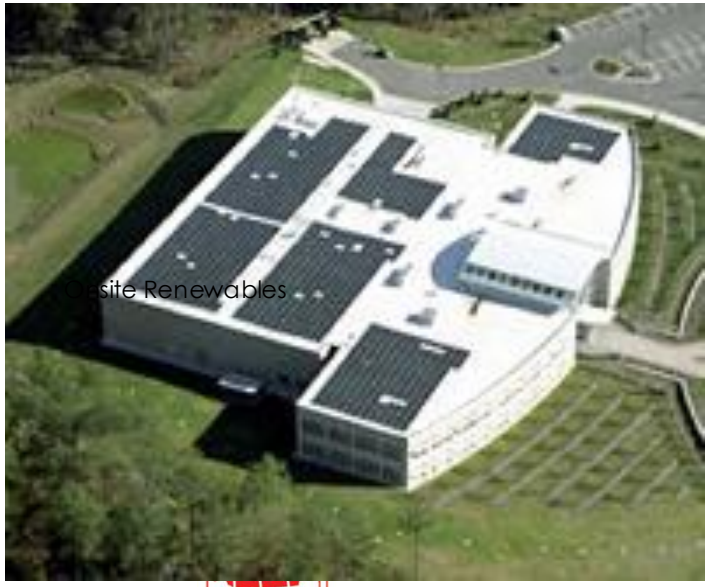


Additional Efficiency Package Options ('2
Section C406

- One additional efficiency feature ***must*** be selected to comply with the IECC:
- C406.2 – Eff. HVAC Performance
- C406.3 – Reduced Lighting Power
- C406.5 – On-site Supply of Renewable Energy
- C406.6 – Dedicated Outdoor Air System
- C406.7 – High Eff. Service Water Heating
- C406.8 – Enhanced Envelope Performance
- C406.9 – Reduced Air Infiltration

More Efficient Lighting System


Site Renewables

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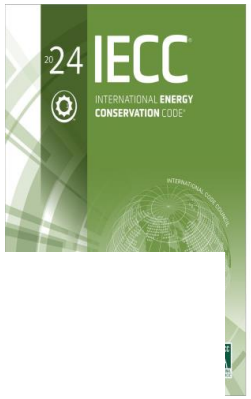
2024 IECC Section R408:



SECTION R408
ADDITIONAL EFFICIENCY ~~PACKAGE OPTIONS~~REQUIREMENTS

R408.1 Scope. This section ~~establishes additional efficiency package options to achieve additional energy efficiency in accordance with Section R401.2.5.~~provides additional efficiency measures and credits required to comply with **Section R401.2.1**.

R408.2 Additional energy efficiency ~~package options.~~credit requirements. ~~Additional efficiency package options for compliance with Section R401.2.1 are set forth in Sections R408.2.1 through R408.2.5.~~Residential buildings shall earn not less than 10 credits from not less than two measures specified in **Table R408.2**. Five additional credits shall be earned for *dwelling units* with more than 5,000 square feet (465 m^2) of *living space* located above *grade plane*. To earn credit as specified in **Table R408.2** for the applicable *climate zone*, each measure selected for compliance shall comply with the applicable subsections of **Section R408**. Each *dwelling unit* or *sleeping unit* shall comply with the selected measure to earn credit. Interpolation of credits between measures shall not be permitted.

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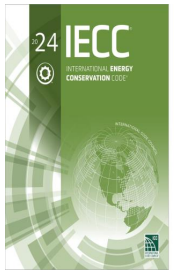
Greatly Expanded Appendices



APPENDIX RH OPERATIONAL CARBON RATING AND ENERGY REPORTING

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

User notes:

About this appendix: *This appendix provides a means to evaluate a building's greenhouse gas performance determined in accordance with* ***ANSI/RESNET/ICC 301****.*

SECTION RH101
GENERAL DEFINITIONS

CO_2e INDEX. A numerical integer value, calculated in accordance with **ANSI/RESNET/ICC 301**, that represents the relative Carbon Dioxide equivalence (CO_2e) emissions of a *rated design* as compared with the CO_2e emissions of the CO_2e reference design, where an Index value of 100 represents the CO_2e performance of the CO_2e reference design and an Index value of 0 (zero) represents a home that emits zero net CO_2e annually.

Additional Efficiency Package Options
Section C406

Buildings shall comply with one or more of the following:

- More efficient HVAC performance
- Reduced lighting power
- Enhanced lighting controls
- On-site renewable energy
- Dedicated outdoor air system
- High efficiency water heating
- **Enhanced envelope performance**
- **Reduced air infiltration**

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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)

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Blower Door Test

- Required in 2012/2015/2018/21/24 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)

Great Liability Protection for Builder/Designer!

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Verifying an Energy Efficient Building Envelope

Blower Door Testing – Recognized by IECC

- Prove Air Sealing
- Envelope Integrity

C402.5 Air leakage—thermal envelope (Mandatory). The *thermal envelope* of buildings shall comply with Sections C402.5.1 through C402.5.8, or the building *thermal envelope* shall be tested in accordance with ASTM E 779 at a pressure differential of 0.3 inch water gauge (75 Pa) or an equivalent method approved by the code official and deemed to comply with the provisions of this section when the tested air leakage rate of the building thermal envelope is not greater than 0.40 cfm/ft^2 (0.2 L/s · m^2). Where compliance is based on such testing, the building shall also comply with Sections C402.5.5, C402.5.6 and C402.5.7.

$$ELR_{75} = \frac{CFM_{75shell}}{area}$$

$$ELR_{75} \leq 0.40$$

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Air Leakage & Continuous Air Barrier Testing

Continuous Air Barrier Required

Two Compliance Options

- ASTM E 779 (blower door test)
- Compliant assemblies

  IECC; C402.5.1 through C402.5.8

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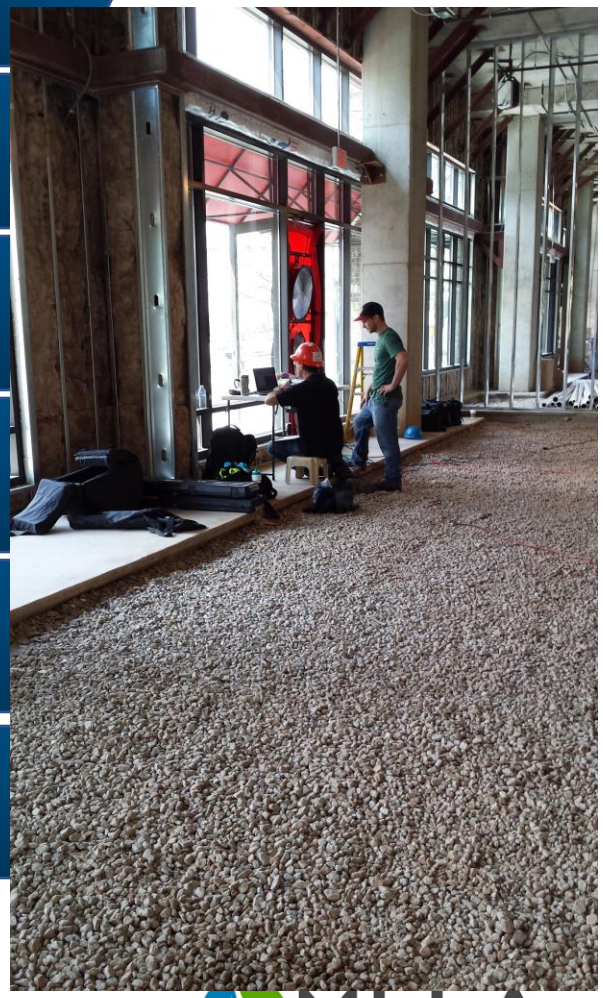
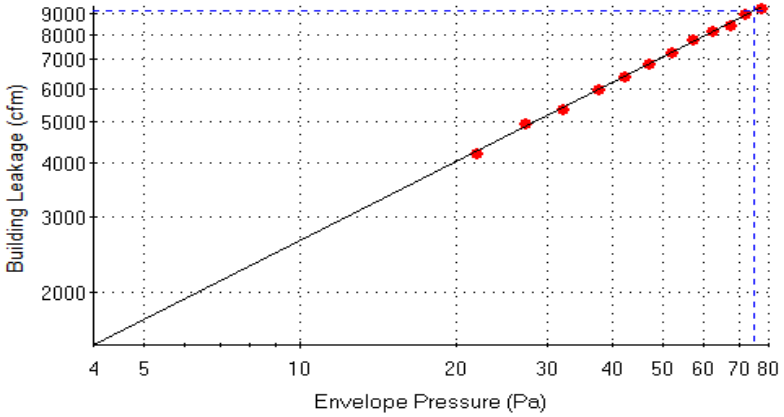
Multi-blower door – envelope leakage test





Label	Base?	start	end	nobs	Avg Pressu	Total Flow
pre depress	True	5571	5686	116	1.92	0
-75Pa	False	7414	7443	30	-75.06	9233.5
-70Pa	False	7469	7498	30	-69.94	8950.7
-60Pa	False	9106	9135	30	-59.98	8128.6
-65Pa2	False	9146	9175	30	-65.08	8381.5
-55Pa	False	9196	9225	30	-55.06	7795.6
-50Pa	False	9244	9271	28	-49.76	7255
-45Pa	False	9286	9313	28	-44.85	6837.3
-40Pa	False	9333	9362	30	-39.97	6360.2
-35Pa	False	9390	9419	30	-35.31	5945.9
-30Pa	False	9476	9503	28	-29.9	5341.5

Copy Data Table to Clipboard

Reporting Pressure (Pa) 75

Test to View test 1

Test 1: Depressurization

Airflow at 75 Pascals
9150 cfm +/- 1.0 %
Range: 9057 to 9243
0.160 CFM @75/sq ft (0.159 to 0.162)

Leakage Areas
EqLA (10 Pa) = 776.6 in2 +/- 2.6 %
ELA (4 Pa) = 426.5 in2 +/- 4.1 %

Building Leakage Curve
Coef. (C) = 639.5 cfm/Pa^n +/- 6.3 %
Exponent (n) = .616 +/- 0.016
Correlation Coef. (r) = .99929
Corr Coef Squared (r^2) = .99857

View / Edit Test Details

Export to Tectite Express...

USACE Report

OK

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Bonus - Reduced Air Infiltration

- Air infiltration verified by whole-building pressurization test
  - Per ASTM E779 or ASTM E1827
  - By an independent third party
- Measured air-leakage rate not to exceed 0.25 cfm/ft^2 under pressure differential of 0.3 inches w.c. (75 Pa), with calculated surface area the sum of above- and below-grade building envelope
- Submit report to code official and building owner, including: tested surface area, floor area, air by volume, stories above grade, and leakage rates

Exception: Buildings over 250,000 ft^2 of conditioned floor area don't need testing on whole building, can test representative above-grade sections. Tested areas to total not less than 25% of conditioned floor area and tested per C406.9

Additional Efficiency Package Options
Section C406

- Reduced Air Infiltration
  - Whole building pressurization testing (ASTM E779 or ASTM E1827) by independent third party
  - Measured leakage rate of ≤ 0.25 cfm/ft^2 (code minimum is ≤ 0.40 cfm/ft^2)
  - Buildings over 250,000 square feet of conditioned floor area may conduct representative area testing
    - Test not less than 25% of conditioned floor area

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HVAC (Just a little bit)

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IECC and IMC

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

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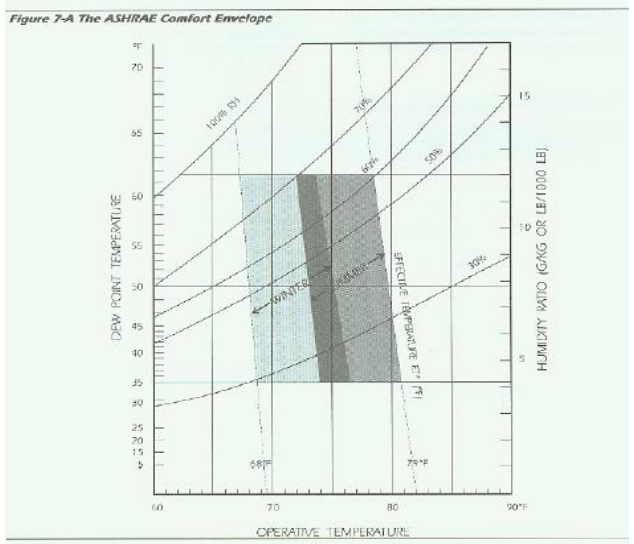
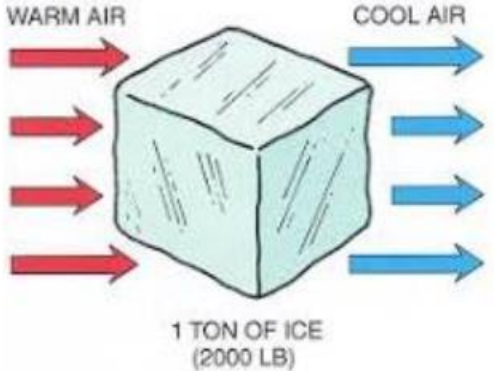
Load Calculations are Mandatory

- Must calculate heating and cooling system design loads
- Must base calculations on generally accepted engineering standards and handbooks – ASHRAE / ACCA 183
- Other approved computation procedures
- Outdoor design conditions
  - Specified by ASHRAE (e.g., Lincoln, NE 2°F winter, 93°F summer)
- Interior design conditions
  - Specified the IECC
  - ≤ 72°F for heating load
  - ≥ 75°F for cooling load



1 ton = 12,000 Btu/hr



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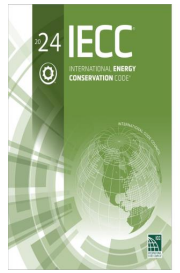
2024 IECC

- **C503.3.5 System sizing.** New heating and cooling equipment that is part of an *alteration*
- shall be sized in accordance with **Section C403.3.1** based on the existing building features as
- modified by the *alteration* .
- **Exceptions:**
- 1. Where it has been demonstrated to the *code official* that compliance with this
- section would result in heating or cooling equipment that is incompatible with the
- rest of the heating or cooling system.
- 2. Where it has been demonstrated to the *code official* that the additional capacity will
- be needed in the future.



Lighting (Just a little bit more)

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LIGHTING CONTROLS
IECC *SECTION C405.2 (MANDATORY)*

Lighting systems required to be provided with controls as specified for:

- Occupant sensor controls – C405.2.1
- Time-switch controls – C405.2.2
- Daylight-responsive controls – C405.2.3
- Specific application controls – C405.2.4
- Manual controls – C405.2.5
- Exterior lighting controls – C405.2.6

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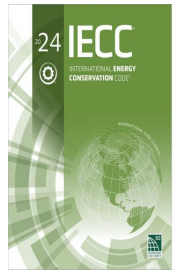
2024 IECC

- **C503.5.1 Interior lighting and controls.** *Alterations* to interior spaces, lighting or controls
- shall comply with the following:
- 1. Where an *alteration* of an interior space includes the addition or relocation of full height
- partitions, the space shall comply with **Sections C405.2**, **C405.3** and **C408.3**.
- 2. Where the lighting within interior spaces is altered, those spaces shall comply with
- **Sections C405.2**, **C405.3** and **C408.3**.
- 3. Where the lighting controls within interior spaces are altered, those spaces shall
- comply with **Sections C405.2** and **C408.3**.
- **Exception:** Compliance with **Section C405.2.8** is not required for *alterations* .



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2024 IECC:

C505.2.4 Lighting. Where a *change of occupancy* or use results in the same or increased *energy use intensity* rank as specified in **Table C505.2.4**, the lighting systems serving the *building* or space undergoing the change shall comply with **Section C405** except for **Sections C405.2.6** and **C405.4**

Systems Commissioning and Completion Requirements
Section C408

- Commissioning is critical to ensure that buildings are **working as designed**
- Preliminary and final reports required
- Mechanical and lighting commissioning detailed in section C408

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Energy Improvements For Existing Buildings

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Overview

- Impact of Improving Existing Building Stock.
- Energy Code Requirements for Existing Buildings
  - Air Barrier
- Prioritizing EE Updates/Upgrades to Existing Buildings
- Defining the Building Envelope & Leakage
- Where Buildings Leak
- HVAC/Lighting/Controls
- Testing/Compliance

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Existing Buildings – Scope ('21 & '24 IECC)
IECC *Chapter 5*

- Applies to alterations, repairs, additions, and change of occupancy (C501.1)
- Additions must comply with code without requiring unaltered portions to comply (C502.1)
  - Specific requirements for new vertical fenestration and skylights (C502.2.1 and C502.2.2)
- Alterations shall not make building less conforming (C503.1)

Image: MontgomeryCountyMD.gov

2024 IECC

- **SECTION C501**
- **GENERAL**
- **C501.1 Scope.** The provisions of this chapter shall control the *alteration* , *repair* , *addition* and *change of occupancy* of existing buildings and structures.

Key Takeaways Overall

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

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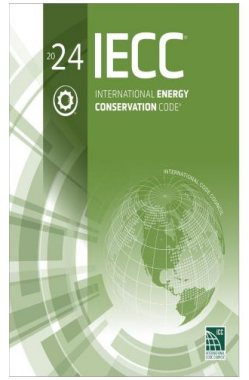
2024 IECC The final result is a code that:

- Modifies Wall insulation and ceiling insulation issues from 2021 IECC – this was the biggest issue with the 2021 IECC
- Expanded the performance path to include equipment trade-offs, duct location trade-offs, and very reasonable envelope backstops
- Includes a much-slimmed down version of the electrification readiness measures in an appendix that would have been if it wasn't for the omnibus



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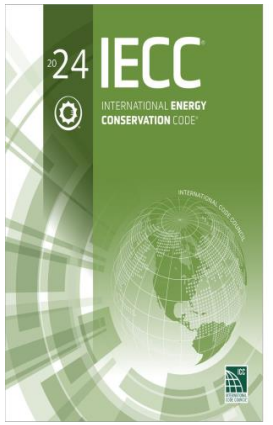
Key Takeaways: 2024



- 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

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Resources

- DOE 2018 IECC Presentation: energycodes.gov/technical-assistance/training/courses/commercial-requirements-2018-iecc
- 90.1-2016 Overview: energy.gov/eere/buildings/articles/new-energy-code-commercial-buildings-standard-901-2016
- DOE 90.1-2016 Presentation: energycodes.gov/resource-center/training-courses/ansiashraeies-standard-901-2016
- Performance Rating Method Reference Manual: pnnl.gov/main/publications/external/technical_reports/PNNL-26917.pdf
- COMcheck: https://www.energycodes.gov/comcheck

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Questions?

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Thank you!

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