Nebraska's Energy Code: Resiliency Through Building and Energy Codes

Nebraska Energy Code Training Program

Instructor: Matt Belcher

November 21, 2024: 11:00 a.m. – 1:00 p.m. CST

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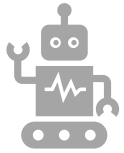
Housekeeping

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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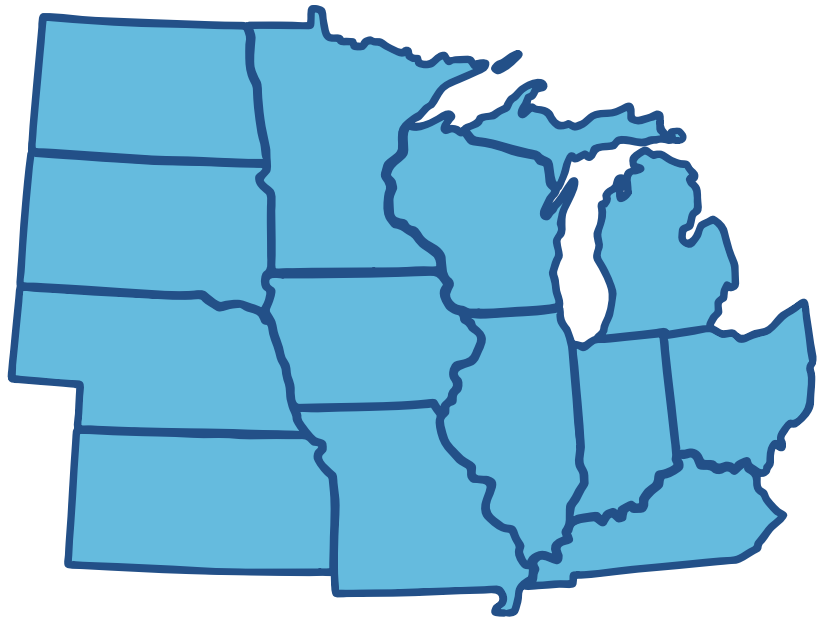
Who We Are

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 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.

Nebraska Energy Codes Training Program

- Goal: prepare the Nebraska workforce for upcoming changes in construction best practices
- Residential and Commercial Energy Code
- 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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THE ENERGY/RESILIENCE NEXUS

- The National Association of State Energy Officials (NASEO) looked at the role of state energy offices in contributing to community resilience with a specific focus on residential structures. NASEO identified numerous challenges to integrating energy efficiency and resiliency into residential rebuilding including motivating property owners and developers to value energy efficiency and disaster resilience during the rebuilding process, identifying and understanding the various sources of rebuilding funding and assistance, and working with property insurance providers to allow upgrades above the value of the pre-existing structure.

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Resiliency:

“The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.”

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Community Focused Resiliency

Energy efficiency measure	Resilience implications
CHP	Provides backup power, allows facilities receiving backup power to double as shelter for displaced residents, reduces overall net emissions, and potentially increases cost savings
Microgrids	May disconnect from grid during power outage, maintaining power supply; allows facilities receiving backup power to double as shelter for displaced residents; reduces overall net emissions; and potentially increases cost savings
Transportation alternatives	Multiple transportation modes that can be used during evacuations and everyday disruptions
District energy systems	Provides heating, cooling, and electricity using local energy sources and reduces peak power demand through thermal energy storage
Utility energy efficiency programs	Increases reliability and reduces utility costs
Energy-efficient buildings	Allows residents/tenants to shelter in place longer, reduces annual energy spending, and reduces overall net emissions. Can help vulnerable populations avoid dangerous and occasionally life-threatening situations in which weather and economics present a dual threat
Green infrastructure	Reduces localized flooding due to storms, reduces energy demand, and reduces urban heat island (UHI) effect in cities and electricity demand
Cool roofs and surfaces	Reduces UHI effect and electricity demand and reduces overall net emissions
Transit-oriented development	Increases economic development opportunities; provides transportation cost savings and reduces impacts of price volatility; and may improve air quality

Figure 7. Energy Efficiency Measures that Reduce Vulnerability and Increase Capacity to Cope [Ribiero et.al. 2015)

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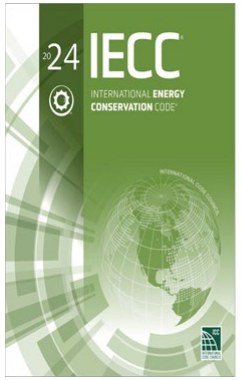
Energy Code Resiliency

- Incorporating measures related to passive survivability can help support resilience on two ends--reducing energy demands through increased efficiency thus reducing grid strain and keeping buildings occupiable for longer periods reducing shelter or other emergency services needs.



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Holistic Approach to Building

- Site Planning and Design
- Resource Efficiency
- Energy Efficiency
- Water Efficiency
- Indoor Environmental Quality
- Homeowner Education
- Global Impact

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Building Focused Resiliency

Benefit type	Energy efficiency outcome	Resilience benefit
Emergency response and recovery	Reduced electric demand	Increased reliability during times of stress on electric system and increased ability to respond to system emergencies
	Backup power supply from combined heat and power (CHP) and microgrids	Ability to maintain energy supply during emergency or disruption
	Efficient buildings that maintain temperatures	Residents can shelter in place as long as buildings' structural integrity is maintained.
	Multiple modes of transportation and efficient vehicles	Several travel options that can be used during evacuations and disruptions
Social and economic	Local economic resources may stay in the community	Stronger local economy that is less susceptible to hazards and disruptions
	Reduced exposure to energy price volatility	Economy is better positioned to manage energy price increases, and households and businesses are better able to plan for future.
	Reduced spending on energy	Ability to spend income on other needs, increasing disposable income (especially important for low-income families)
	Improved indoor air quality and emission of fewer local pollutants	Fewer public health stressors
Climate mitigation and adaptation	Reduced greenhouse gas emissions from power sector	Mitigation of climate change
	Cost-effective efficiency investments	More leeway to maximize investment in resilient redundancy measures, including adaptation measures

Figure 6. Resilience Benefits of Energy Efficiency (Ribiero et.al. 2015)

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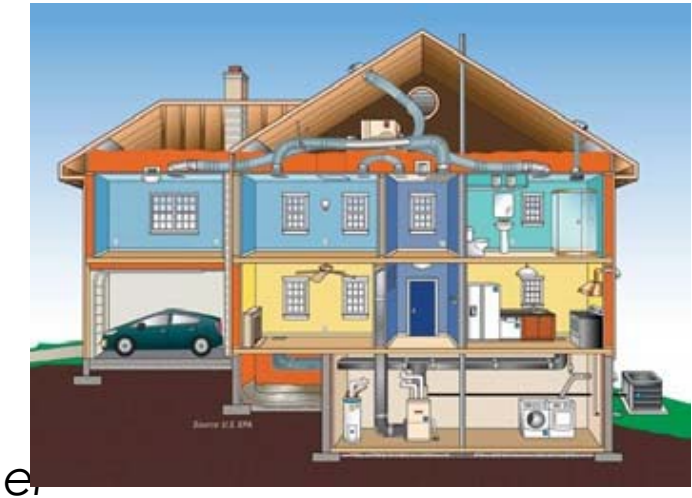
Building Thermal Envelope

A well-designed building envelope promotes energy conservation and Resilience 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.

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Energy Code Impact

- Multiple provisions within the energy code contribute to conditions that support passive survivability.
- Enclosure criteria around insulation, air barriers, solar heat gain, glazing and fenestration support temperature-related aspects.
- The building enclosure performance centers on passive survivability

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Energy Code Impact (cont.)

- Pipe insulation can prevent the freezing of pipes during extreme cold events.
- Daylighting can support continued use of spaces when emergency lighting is insufficient or if/when back-up power runs out.
- Access to daylight may also support occupant mental health during an otherwise stressful time.

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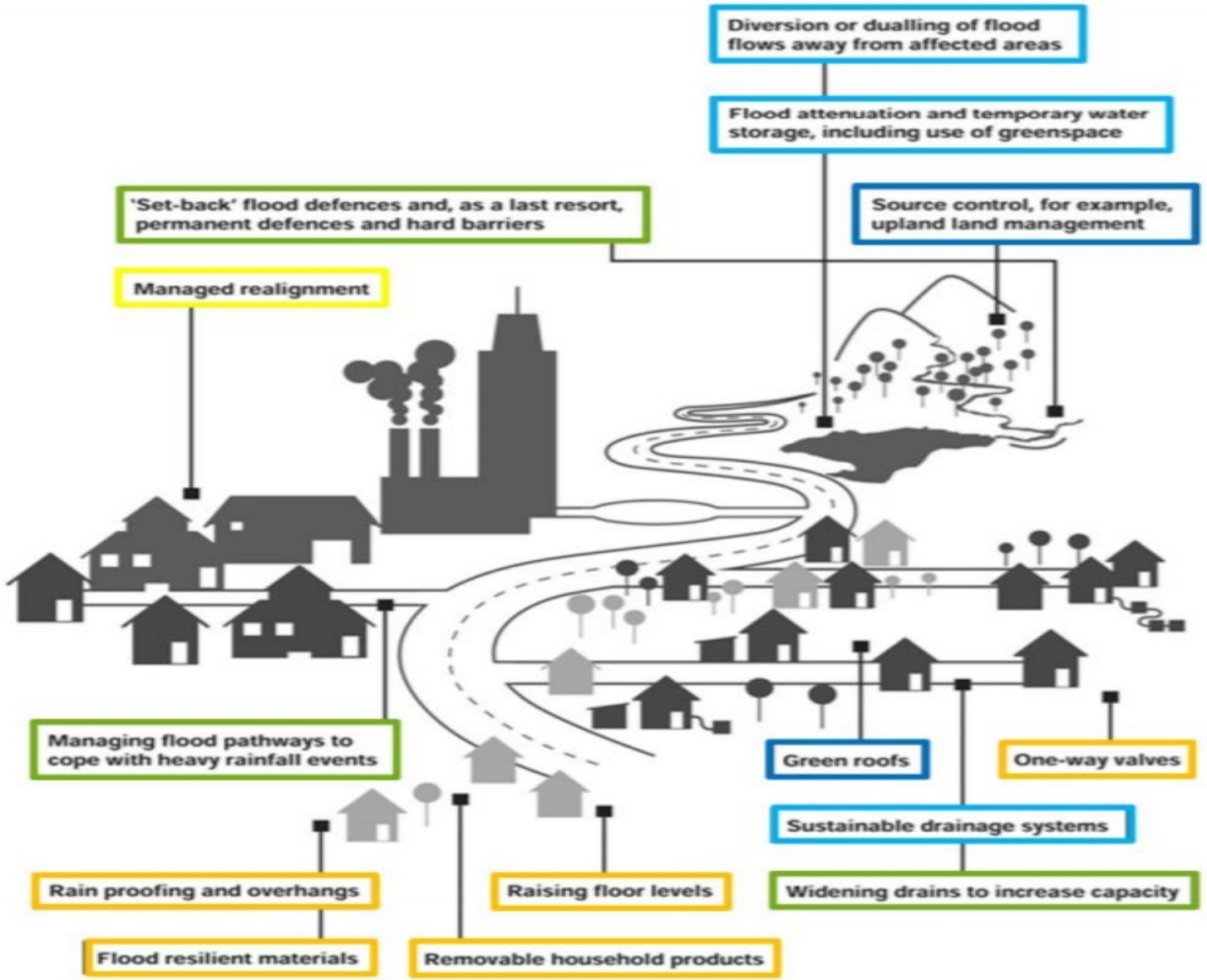
Other Impacts

- Extreme temperature and some water-related events (e.g., flooding, hurricanes, severe storms) Creating incidents of
- mold, mildew and other indoor environmental quality issues may arise.
- Rot and durability issues are also of concern.



Retain

Relieve

Resist

Retreat

Accommodate

Prepare

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How the Energy Code Helps

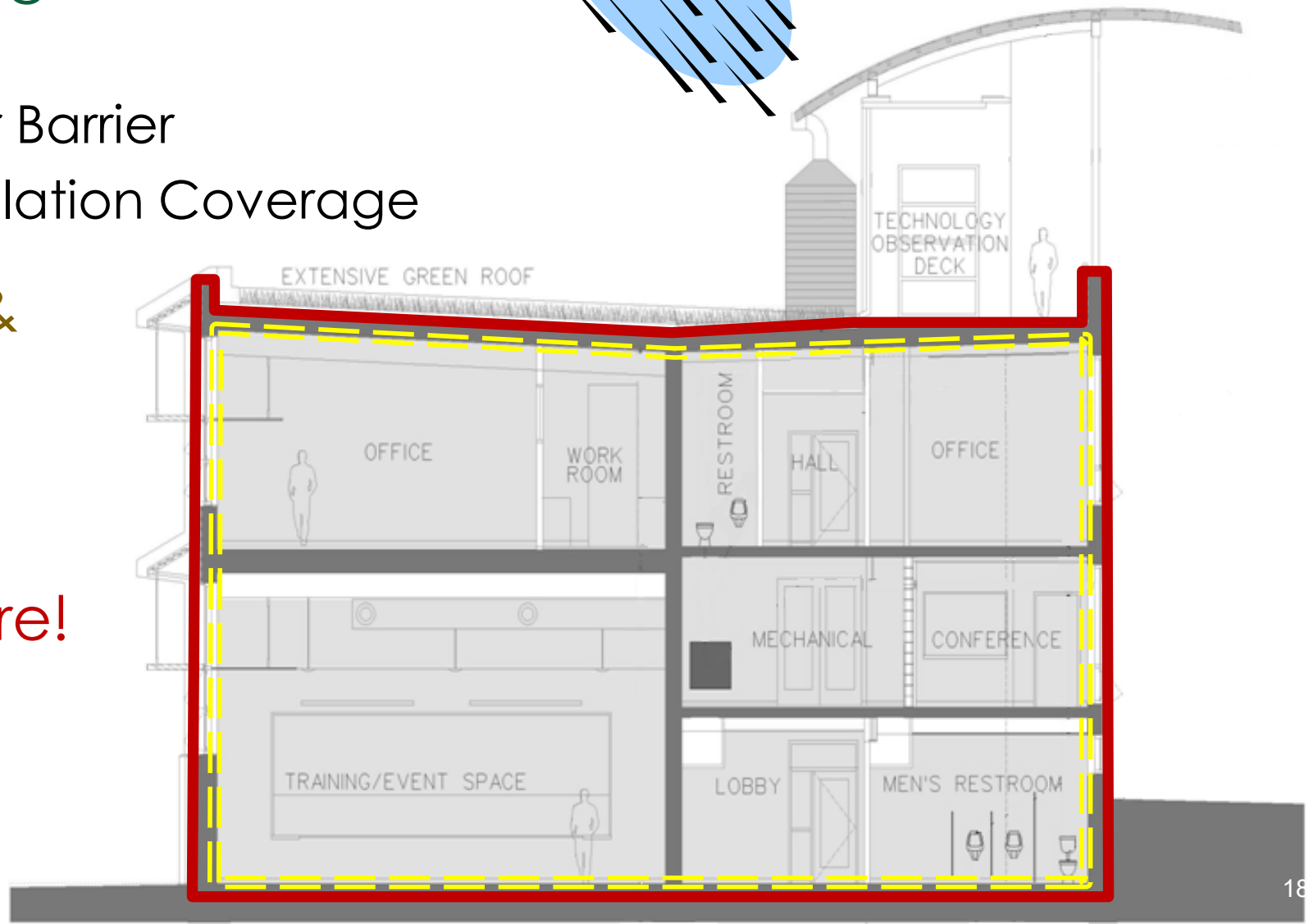
The energy code dives deep into the field of building science—controlling heat, air, and moisture transfer in building enclosures.

Buildings are Systems

Complete Building Thermal Envelope

- Continuous Air Barrier
- Complete Insulation Coverage

- Proper Heating & Cooling Systems
- Controlled Ventilation
- Deal with Moisture!



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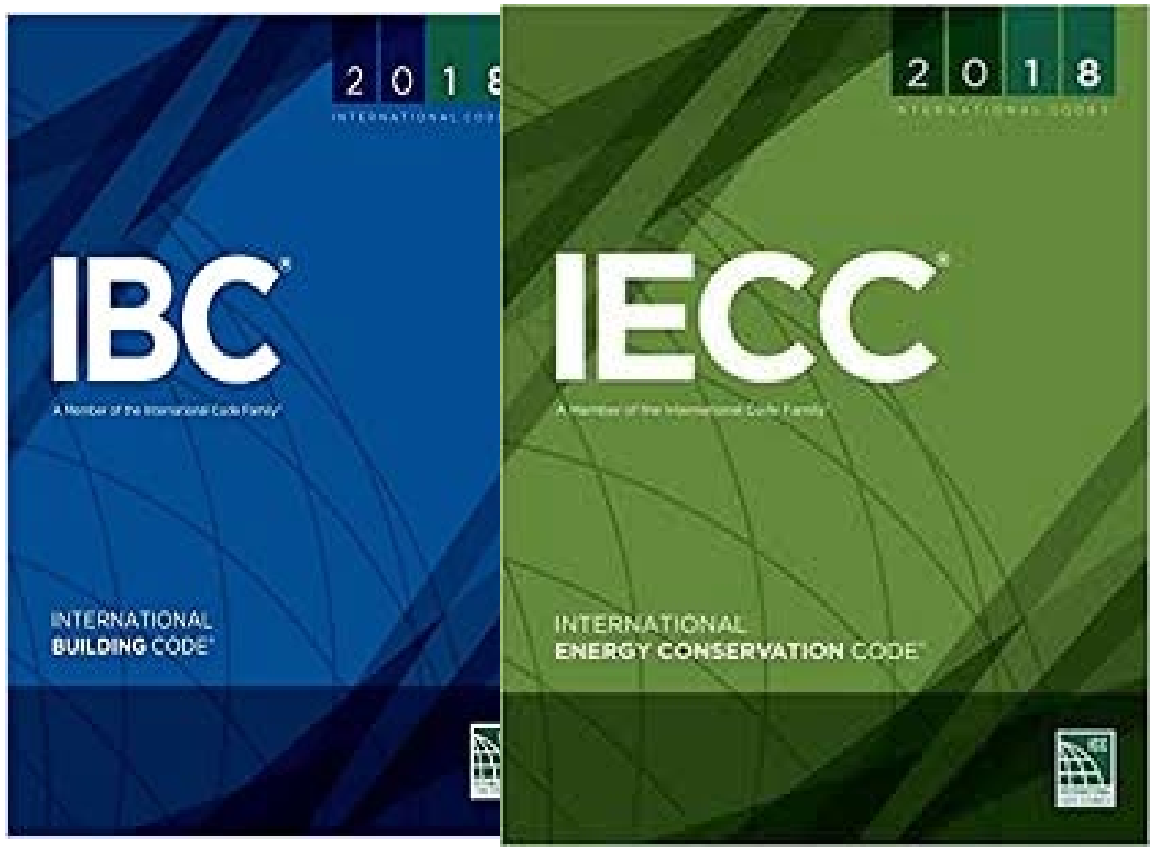
IECC and IBC

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



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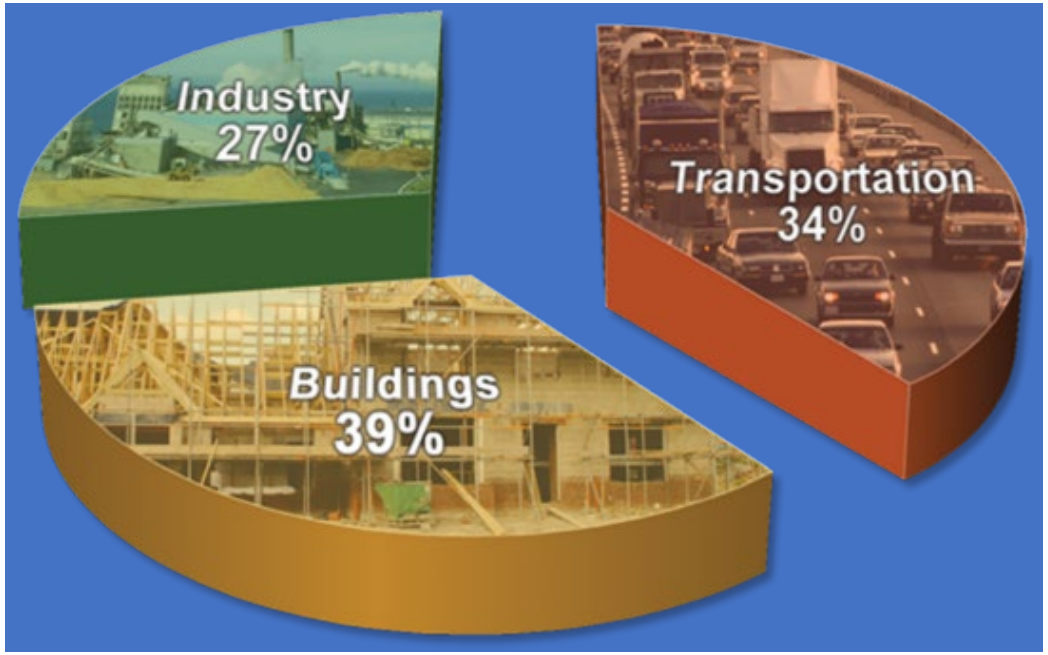
Selected Code Topic	Relevant Sections (2018 IECC)	Supported Resilience Strategy	Relevant Hazards
Insulation	C402.2, R402.2	▪ Passive survivability ▪ Reduced energy burden ▪ Reduced grid impact ▪ Reduced ice-dams ▪ Reduced condensation, limiting mold and mildew	▪ Extreme heat ▪ Extreme cold ▪ Snow storms ▪ Social resilience ▪ Secondary impacts to all hazards
Walk-In Coolers and Freezers	C403.10	▪ Food safety/preservation	▪ Extreme heat ▪ Secondary impacts to all hazards
Daylighting	C402.4.1	▪ Passive survivability ▪ Reduced grid impact	▪ Extreme heat ▪ Secondary impacts to all hazards
Window-to-Wall Ratios	C402.4.1, R402.3	▪ Passive survivability ▪ Impact vulnerabilities	▪ Extreme heat ▪ Extreme cold ▪ Hurricanes ▪ Tornadoes
Solar Heat Gain Coefficient	C402.4.3, R402.3.2	▪ Passive survivability ▪ Reduced grid impacts	▪ Extreme heat ▪ Secondary impacts to all hazards
Solar Reflectance of Roof	C402.3	▪ Urban heat island ▪ Passive survivability	▪ Extreme heat ▪ Secondary impacts to all hazards
Air Leakage	C402.5, R402.4	▪ Contaminants (secondary to wild-fire, earthquake, etc.) ▪ Mold and mildew (secondary to flooding, hurricane, extreme cold, etc.)	▪ Secondary impacts to all hazards
Pipe Insulation	C404.4, R403.4	▪ Passive survivability ▪ Reduced energy burden	▪ Extreme cold ▪ Drought ▪ Social resilience
On-Site Renewable Energy	C406.5, Appendix CA, Appendix RA	▪ Contribute to distributed generation ▪ Facilitates islandability	▪ Secondary impacts to all hazards

Table 1. Select Energy Code Provisions Contributing to Resilience

Why are Energy Codes Important?

- Reduces energy use of buildings
- Impacts energy use for the life of a building
  - Most cost-effective to implement during initial design and construction
- Benefits building owners and operators by guaranteeing a minimum of efficiency
- Health and resilience benefits to building owners and occupants



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The Energy Code and Building Energy Efficiency

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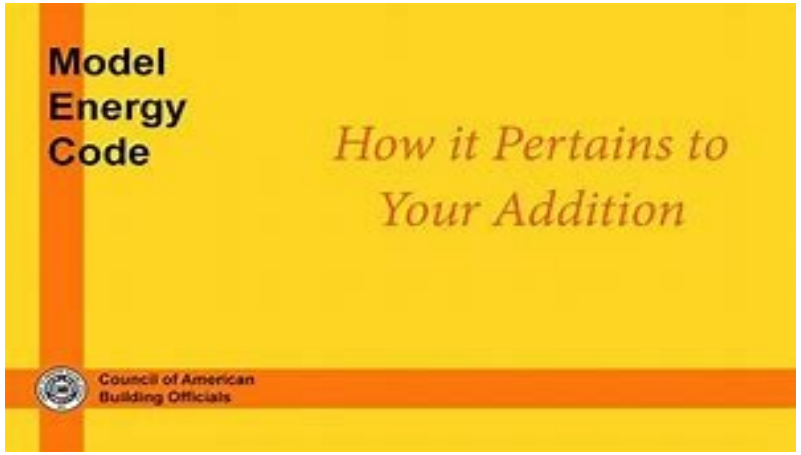
The Energy Code

- Model Energy Code (MEC) developed in 1983 under a U.S. Dept of Energy Contract
- Editions of the MEC released from 1983-1995
- Title changed to International Energy Conservation Code in 1998



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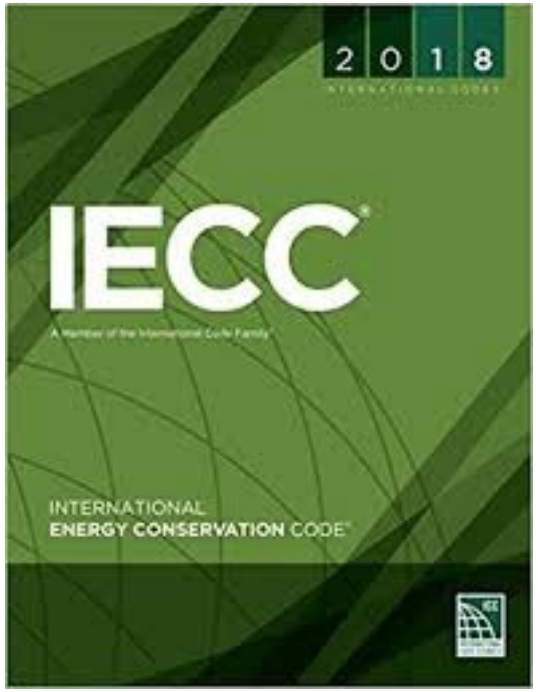
International Energy Conservation Code (IECC)

- Developed by the International Code Council
  - Robust stakeholder process
  - Proposed changes accepted from all parties
- New editions published every 3 years



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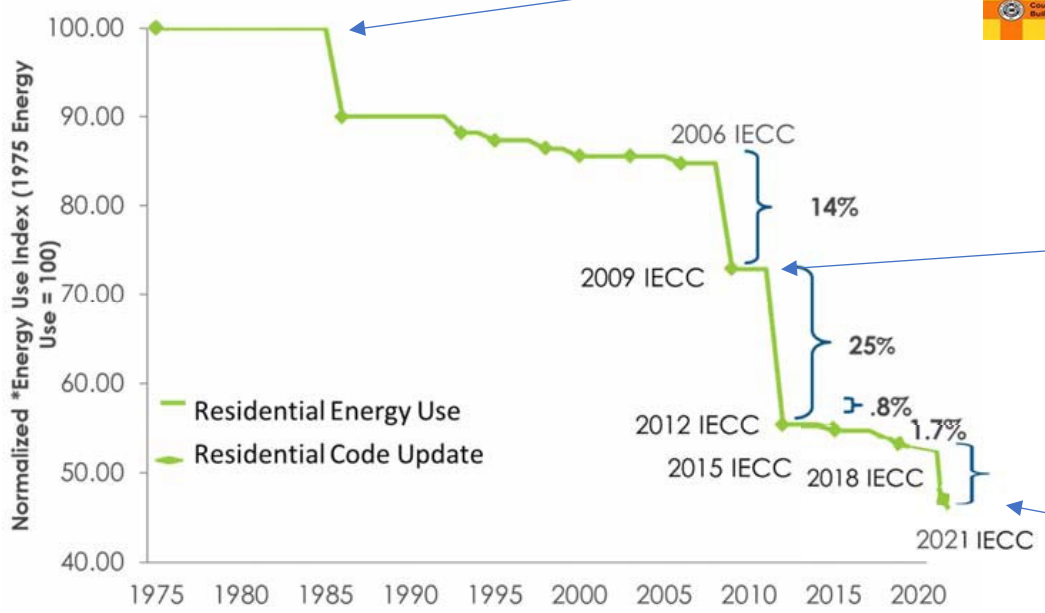
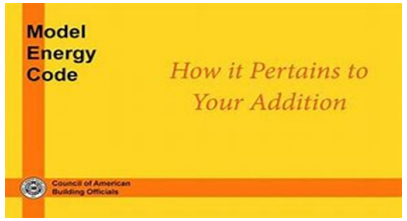
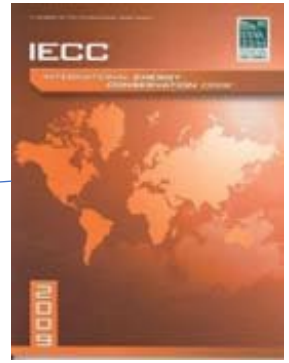
Energy Code Background







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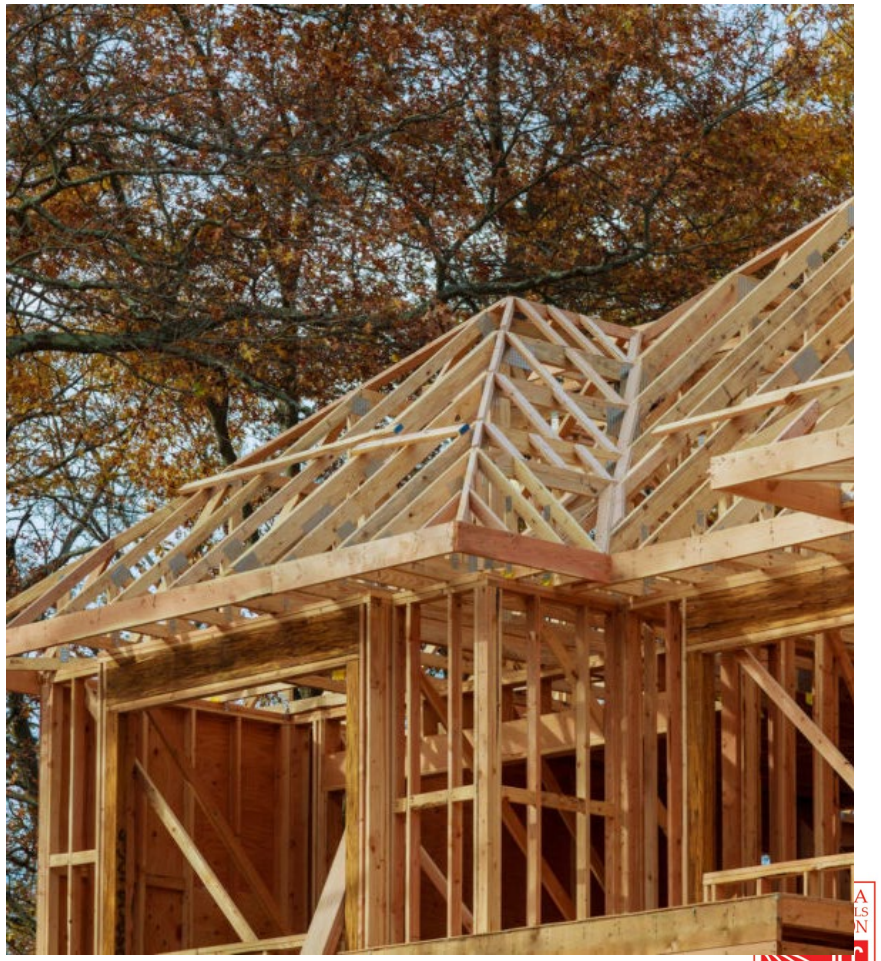
The Energy Code is Everywhere

- 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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Advanced Framing

- Everything lines up!
- 2x6 framing @ 24” centers
- **Fewer studs = more insulation = better efficiency**

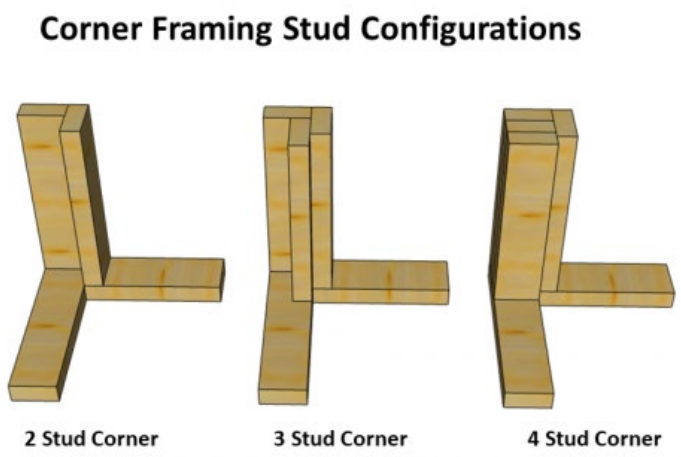
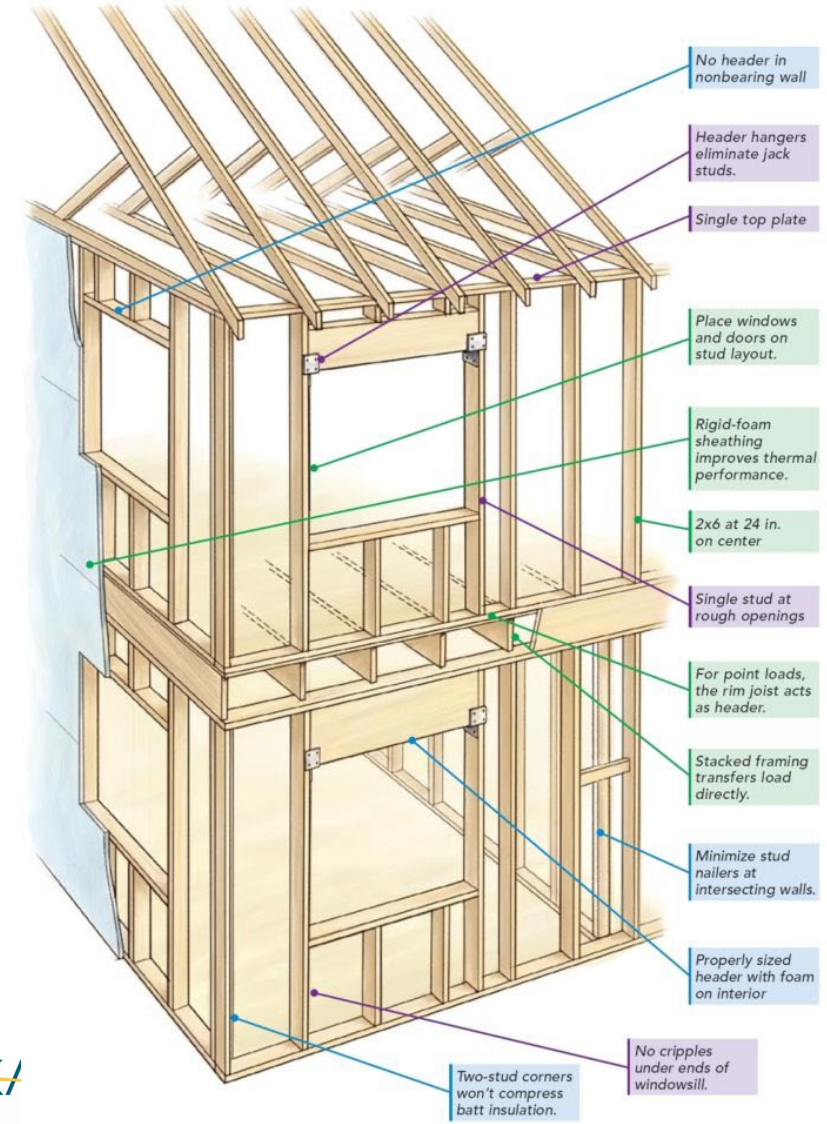


Image: greenbuildingadvosor.com; builderscalculator.com



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Continuous Insulation - Typical Framing

- Typical wall with continuous insulation on the exterior
- Be sure to **seal all seams** in continuou insulation
- Stud cavity can accommodate various types of insulation

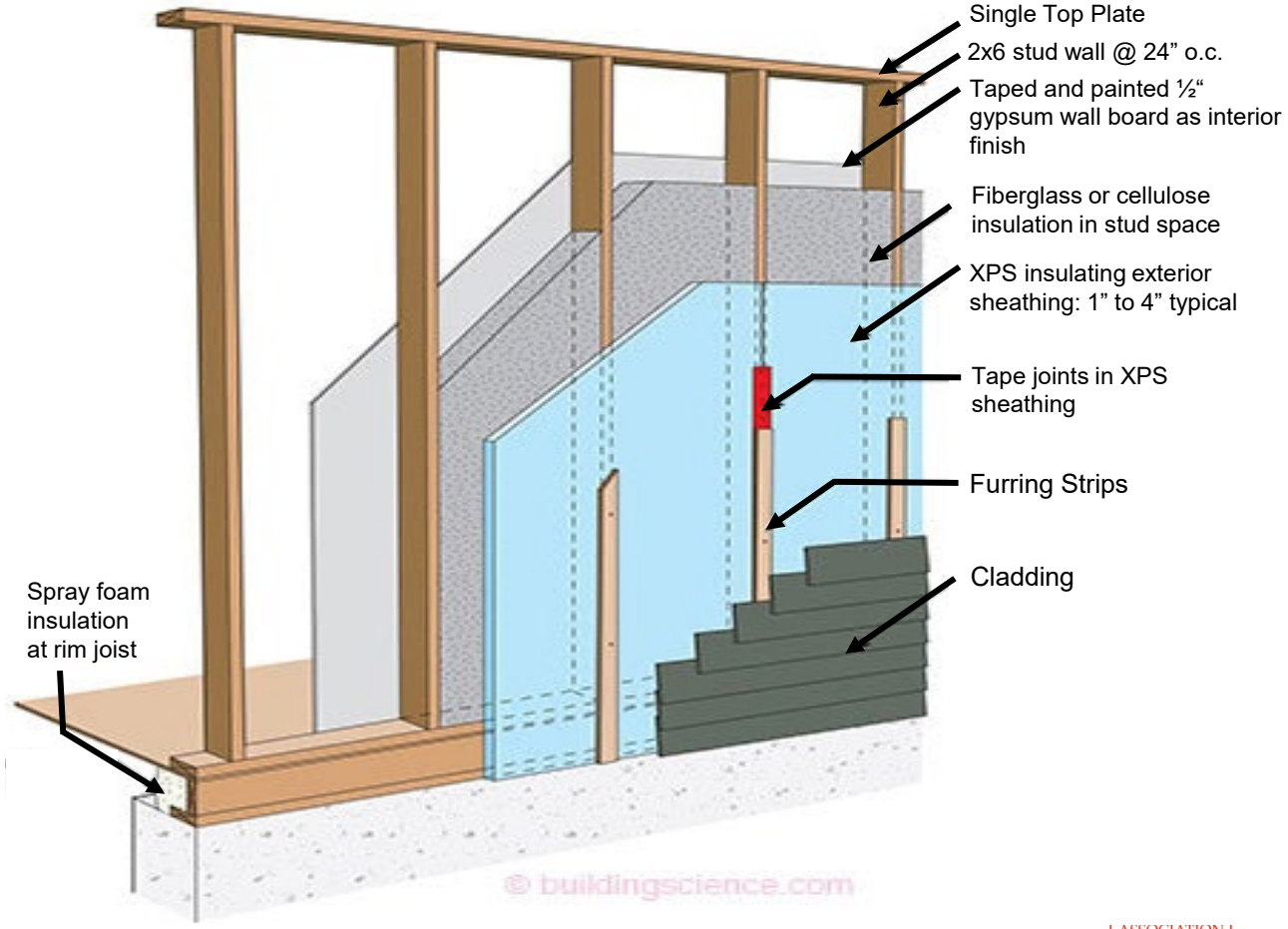

Image: buildingscience.com

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

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2018 IECC

- Advances Energy Code approximately 28% over the 2009 IECC
- Residential and Commercial provisions
- Testing and verification required
- Equipment details and location identified.
- Design/performance verification of lighting controls
- Adds an appendix for “Solar Ready Zones”

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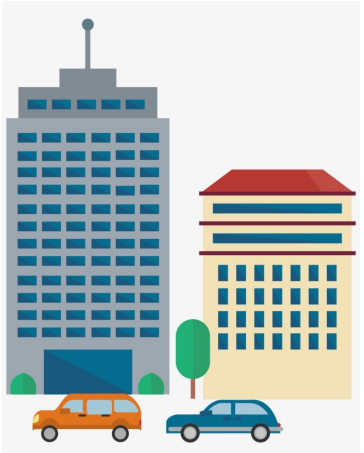
Commercial Buildings in the IECC

Under the Purview of the Commercial Code

- ✓ Buildings with commercial use
- ✓ Multifamily residential buildings four stories or greater in height



Not Under the Purview of the Commercial Code

- × One- and two-family residential
- × R-2, R-3, R-4 three stories or less in height

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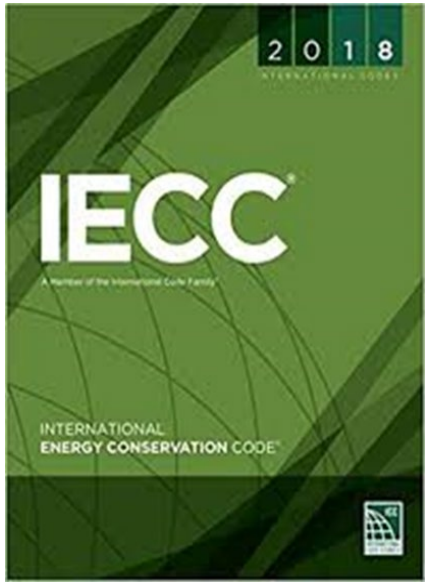
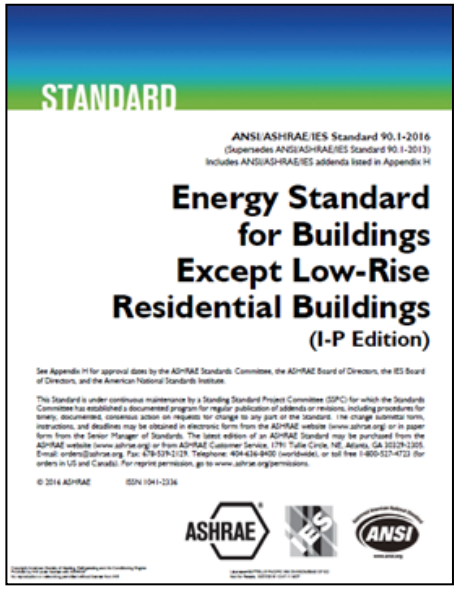
New in 2018: *Two* Commercial Compliance Options



ASHRAE 90.1-2016

Alternative Method to IECC



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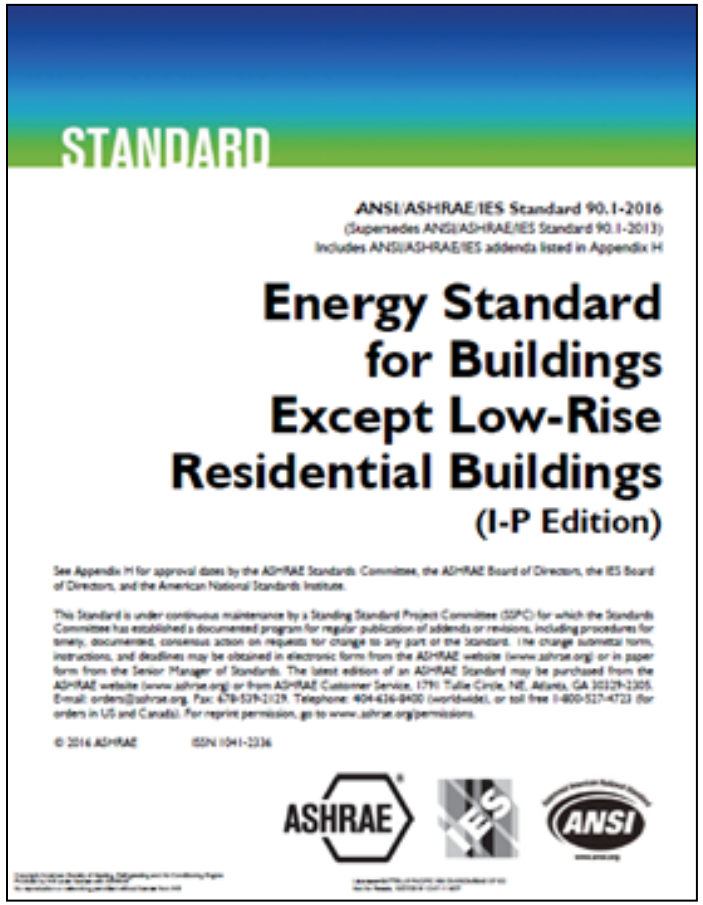
Structure of Standard 90.1-2016



1. Purpose
2. Scope
3. Definitions, Abbreviations & Acronyms
4. Administration and Enforcement
5. Building Envelope
6. Heating, Ventilating and Air Conditioning
7. Service Water Heating
8. Power
9. Lighting
10. Other Equipment
11. Energy Cost Budget Method
12. Normative References

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Moisture Management

It Connects EVERYTHING!

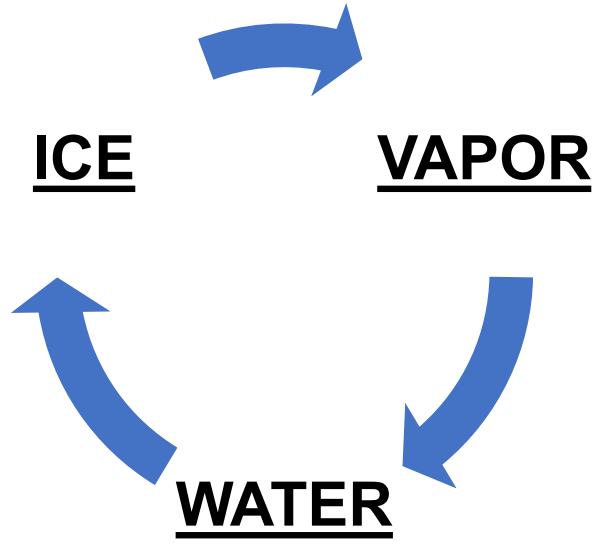
Prioritizing Moisture Movement

#1 – Bulk Water

#2 – Capillary Water

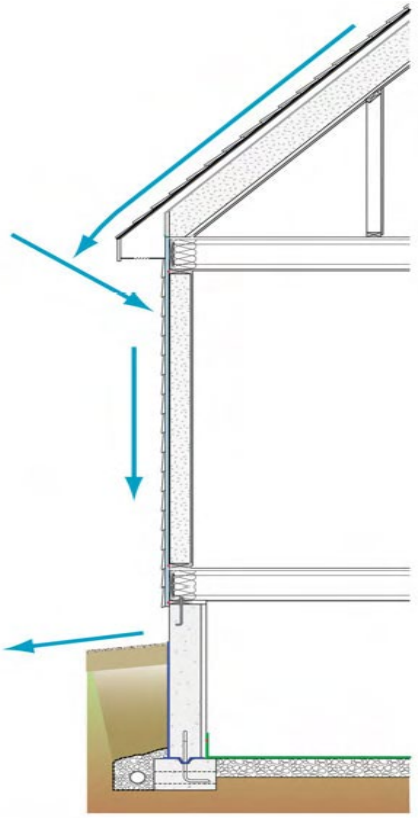
#3 – Air-Transported Moisture

#4 – Diffusive Moisture Movement



Bulk Water Management – Priority #1

The key is proper **drainage!**



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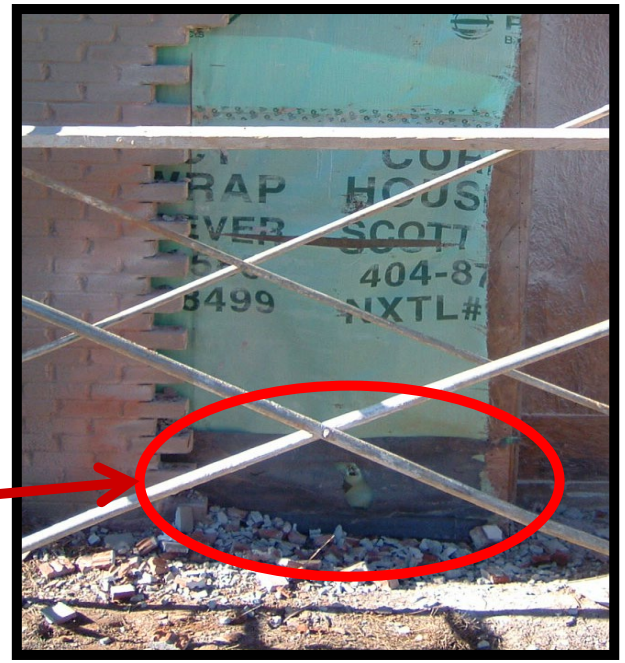
Properly Lap Flashing

- The mason's flashing (black) was installed after and in front of the house wrap (green). This is reverse flashing that will trap any drain water that gets past the brick veneer.



Always Allow For Drying

Exterior Conditions
Temperature: 80° F
Relative Humidity: 75%
Vapor Pressure: 2.49 kPa

Conditions Within Cavity
Temperature: 120° F
Relative Humidity: 100%
Vapor Pressure: 11.74 kPa

Interior Conditions
Temperature: 75° F
Relative Humidity: 60%
Vapor Pressure: 1.82 kPa

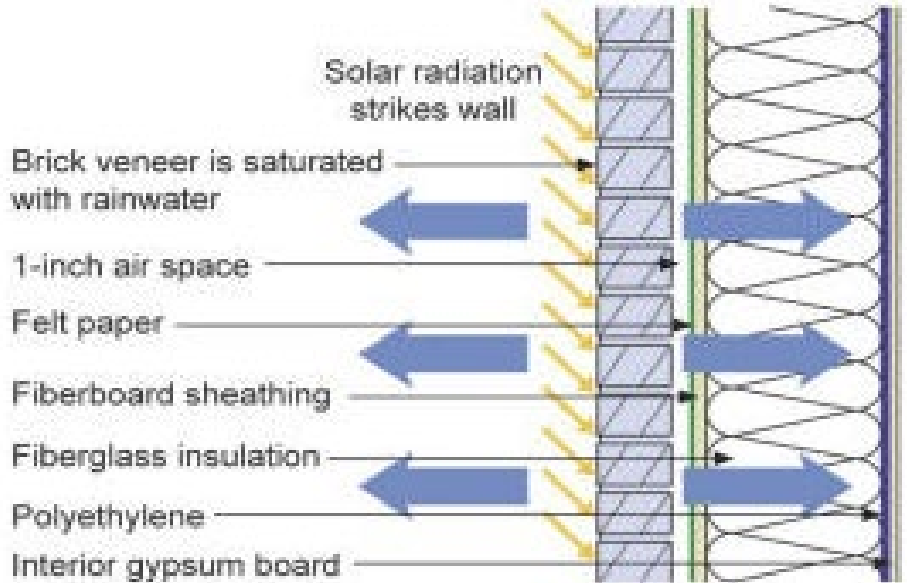


Image by Building Science Corp.

Vapor is driven both inward and outward by a high vapor pressure differential between the brick and interior and the brick and exterior

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Quality Management

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

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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)

IECC and IMC and Resiliency

Energy codes may also help avoid additional cascading effects following a disaster. This is particularly true for provisions concerning the building envelope and ventilation.

- **Wildfires and other disasters that generate airborne particulates could present health concerns for citizens still in the area.**
- **Controlled ventilation practices may reduce the level of air pollutants indoors, allowing for extended occupancy.**
- **reducing the potential incidents of illness like asthma in a health system already under stress.**

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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

HVAC Design and Loads

Oversized systems:

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

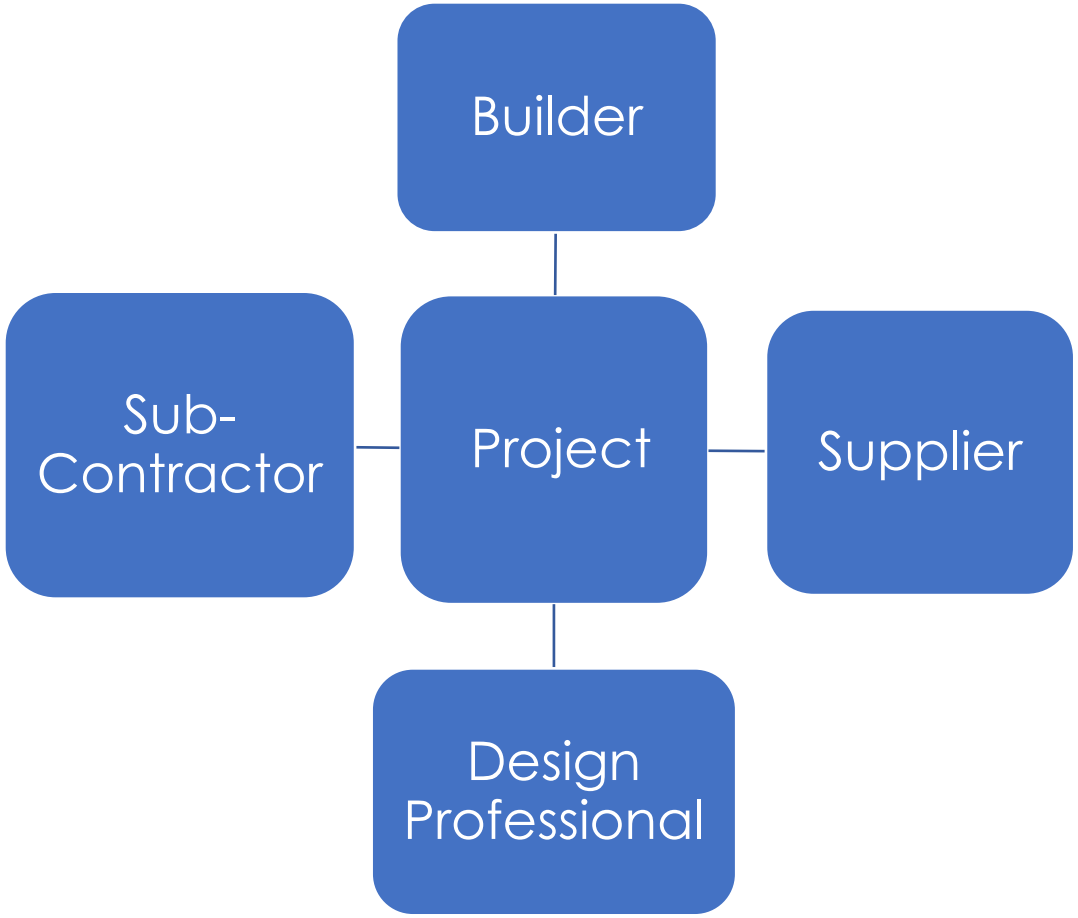
Right-sized systems:

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

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

Establishing a Knowledgeable Team



Major Building Envelope Protection Systems

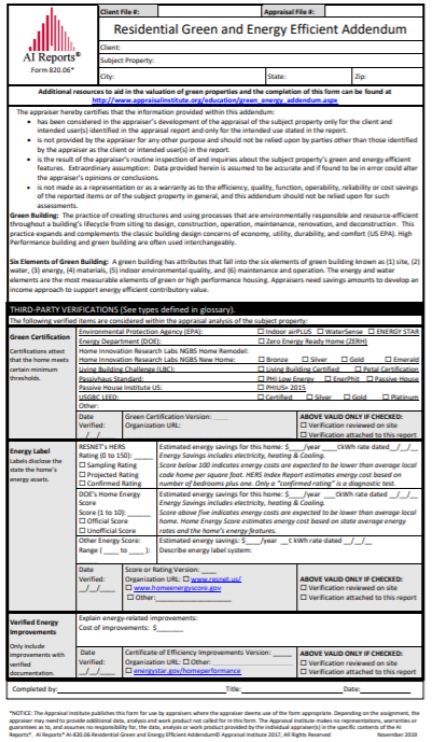
- Water Barrier
- Air Barrier
- Thermal Barrier
- Vapor Profile (not just the designated vapor retarder)
- Maintenance documents

Appraisals and Resale Value

Business Impacts

Residential Green and Energy Efficient Addendum

- Resources for realtors and appraisers on properly valuing energy efficiency/green features
  - Educational materials
  - List of designated appraisers
  - Trainings
- For more information: http://www.appraisalinstitute.org/education/green_energy_addendum.aspx


Residential Green and Energy Efficient Addendum

Form 820.04

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CONCLUSION

- From their initial creation through today, building energy codes have played a major role in reducing the impacts of adverse events. Before, during and after disasters building energy codes influence both individual and community capacity to withstand and bounce back from such events.
- As policymakers consider approaches that enhance resilience, energy codes should be a cornerstone.

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CONCLUSION (cont.)

- Discussion is emerging around the development of immediate occupancy codes or functional recovery standards that focus on keeping buildings occupiable and operational following a hazard event (rather than just immediate life-safety).
- As the conversation advances, participants should be cognizant of the important role energy plays in the functionality of buildings.
- energy efficiency and strategies contained in energy codes can contribute to keeping a building functional.

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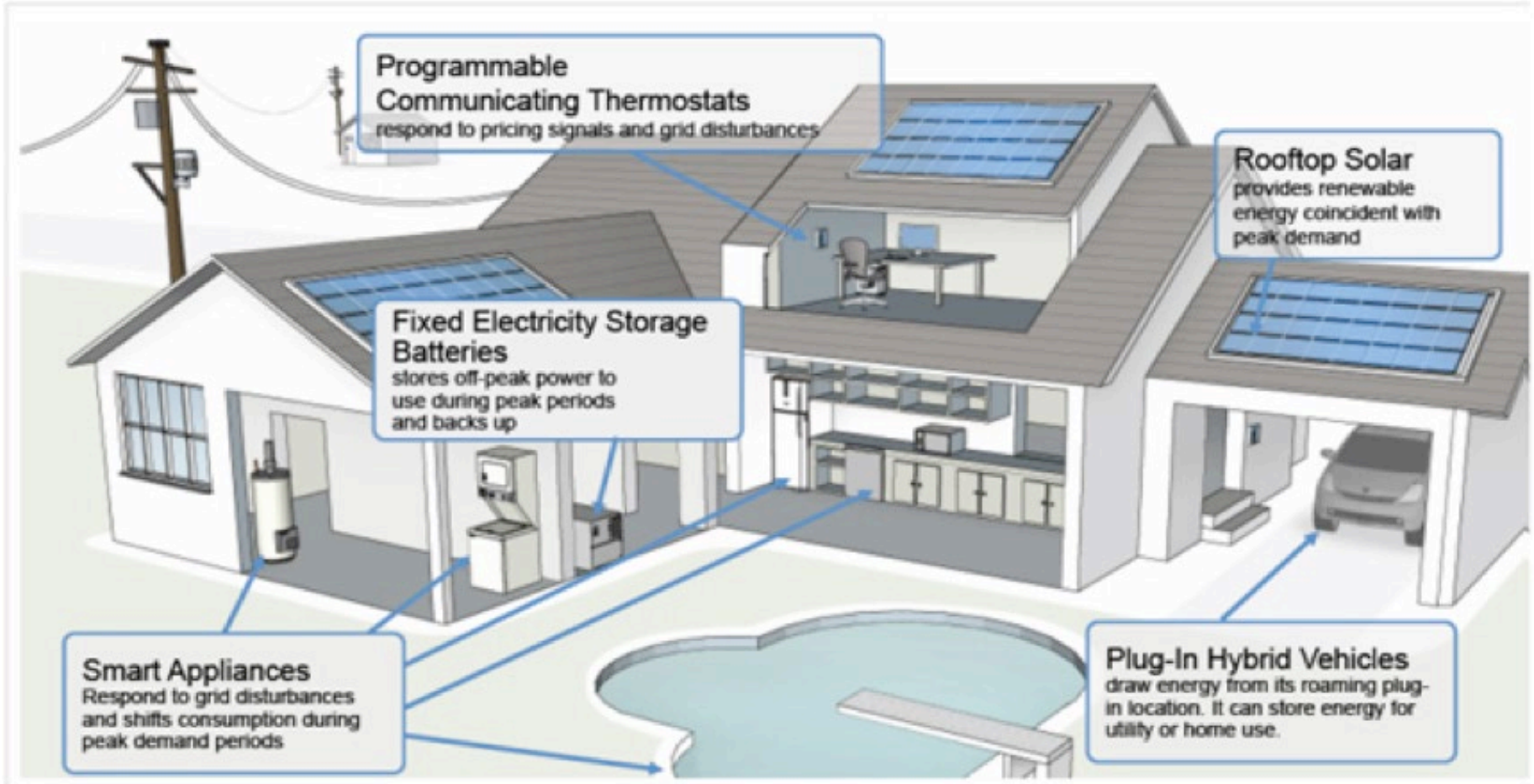
2024;The Low Impact, Energy Efficient, Resilient, Healthy, Cost Effective, Comfortable, Grid Interactive, Place we call Home!



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Questions?

Thank you!

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Thanks to ICC for their Support and Information!

For more information ICC Members can access this report online:

- 1918078_GR_ANCR_IECC_Resilience_White_Paper_BRO_Final_midres.pdf

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