An Introduction to ASHRAE 90.1-2019

December 9, 2024

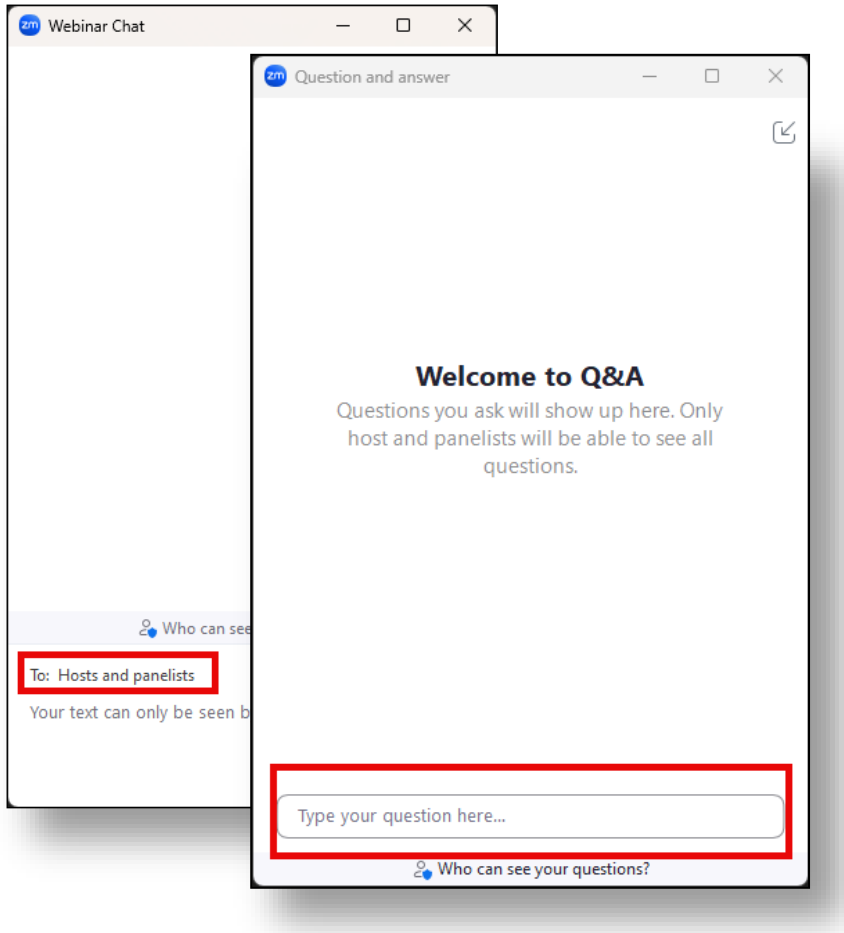
U.S. Department of ENERGY | Office of Energy Efficiency & Renewable Energy

Webinar Instructions

- PowerPoint and webinar recording will be available on the HUD Exchange
- Participants are in ‘listen only’ mode
- Submit content related questions in the Q&A
- For technical issues, request assistance through the chat box

Technical Issues? Questions?

- Chat
  - Submit any technical issues via the chat box
    - Send the message to the Host
    - Host will work directly with you to resolve those issues
- Q&A
  - Submit any content related questions via the Q&A box



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Energy Code Webinar Series

Implementing HUD's New Minimum Energy Standards for HOME and Housing Trust Fund Projects	November 19, 2024 2:00-3:30 PM EST
An Introduction to the 2021 IECC	December 3, 2024 2:00-3:30 pm EST
An Introduction to ASHRAE 90.1-2019	December 9, 2024 2:00-3:30 PM EST
Alternative Compliance Pathways	TBD

Register for the Energy Code Webinar Series at www.hudexchange.info/trainings

Today's Presenters

Andrew Poling

Program Analyst

Office of Environment and Energy

U.S. Department of Housing and Urban Development

Paula M. Zimin, AIA

Senior Research Analyst

Pacific Northwest National Laboratory

Background

Context

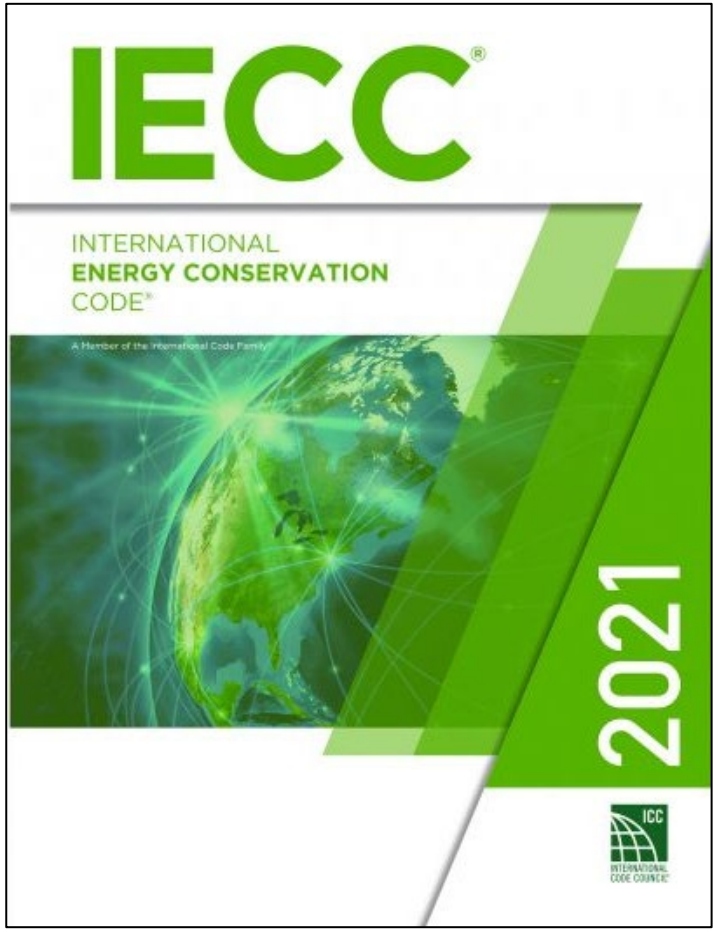
The Energy Independence and Security Act of 2007 (EISA) requires HUD and USDA to jointly adopt the most recently published energy standards subject to a housing "affordability and availability" test. HUD and USDA currently require 2009 IECC and ASHRAE 90.1-2007.

The Final Determination, published in the Federal Register on April 26, 2024, brings HUD and USDA into compliance with EISA by adopting 2021 IECC and ASHRAE 90.1-2019 as minimum energy standards.

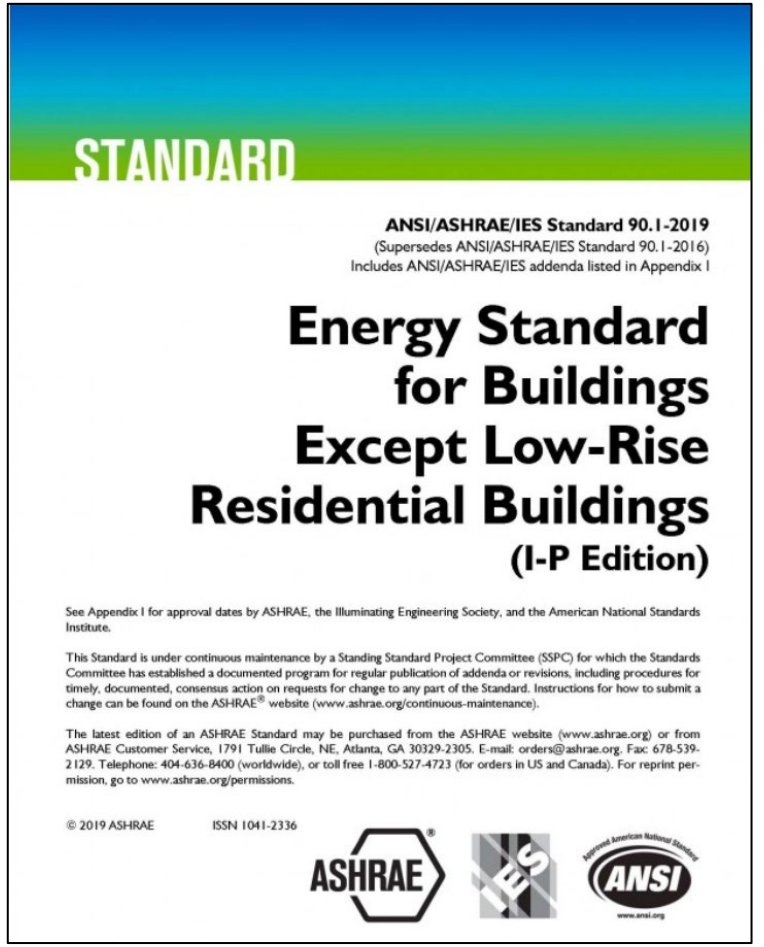
This notice impacts new construction only.

The updated energy code does not apply to FHA-insured or USDA mortgage financing for existing housing or manufactured housing.

Two Codes Specified in Statute



Single Family + Low-Rise Multifamily



Multifamily 4+ Stories

Anticipated Benefits

Initial and ongoing cost savings

Health Benefits

Enhanced Comfort

Resilience to extreme weather events

Estimated Savings of ASHRAE 90.1-2019

- ASHRAE 90.1-2019 is 22.5% more efficient than the 2007 standard
- Aggregate energy savings are estimated at $1.1 million per year or $53 million over 30 years

Compliance Dates for Multifamily Programs

Program	Event that Triggers Compliance	Final Determination (Current)
Rental Assistance Demonstration	Required by Federal Register Notice published on July 27, 2023	Already implemented and applicable to new construction
HOME/Housing Trust Fund (HTF)	Participating Jurisdiction or HTF grantee funding commitment	180 days after effective day (6 months) or November 28, 2024*
FHA-Insured Multifamily	**Pre-application submitted to HUD**	**12 months after effective date or May 28, 2025**
Public Housing (Capital Fund, Project Based Vouchers)	HUD approvals of development proposals for new Capital Fund, mixed financed projects, and PBVs	12 months after effective date or May 28, 2025
Competitive Grants (Choice Neighborhoods, Section 202, Section 811)	NOFO publication	Next published NOFO after effective date
All programs, persistent poverty rural areas	-	24 months after effective date or May 28, 2026

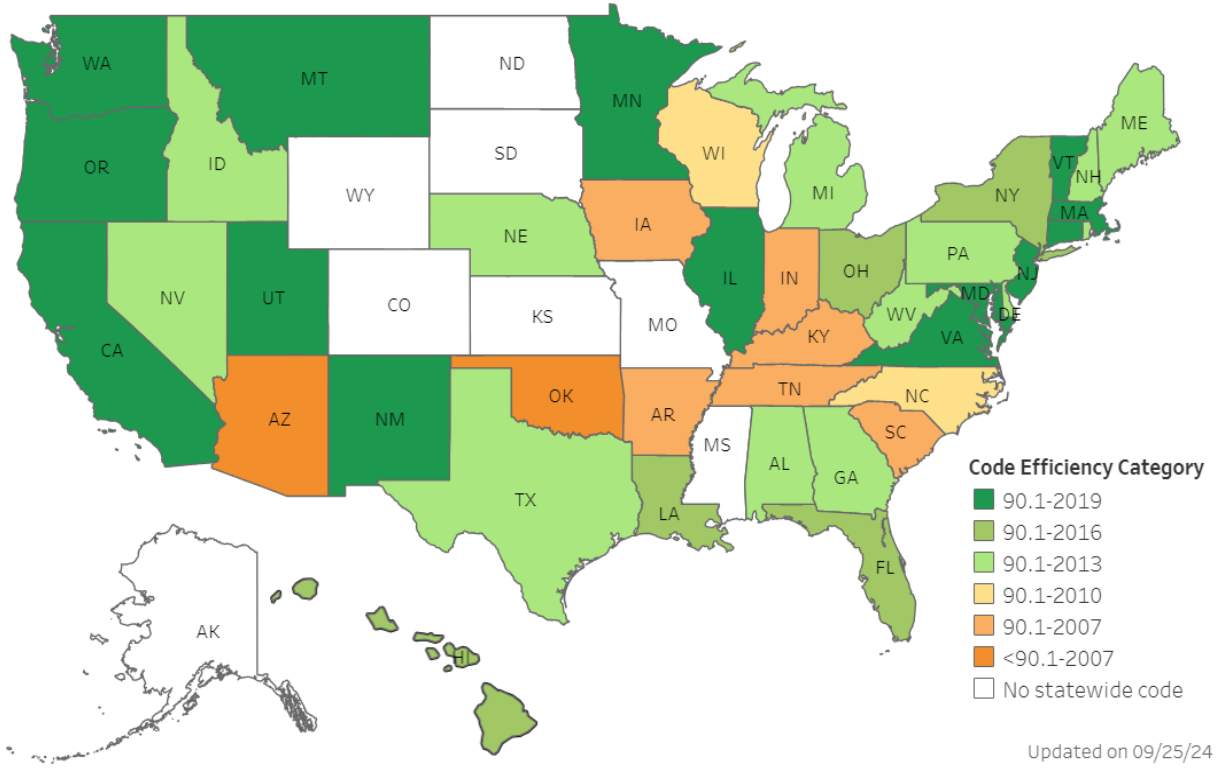
*If HOME/HTF funding is layered with other HUD funds, the later program compliance date applies.

Alternative Compliance Pathways

- Industry is already building to standards that meet or exceed the 2021 IECC or ASHRAE 90.1-2019
  - Low Income Housing Tax Credit (LIHTC) Qualified Allocation Plans often require or incentivize high-performance building standards
  - Tax credits available for building to ENERGY STAR program requirements or certifying to DOE's Zero Energy Ready Home Program
- HUD will publish a list of high-performance building standards that will be accepted as alternate compliance pathways
  - These may include ENERGY STAR Certified Homes, DOE's Zero Energy Ready Home Program, and other high performance building standards that set or incentivize 2021 IECC or ASHRAE 90.1-2019 as baseline standards

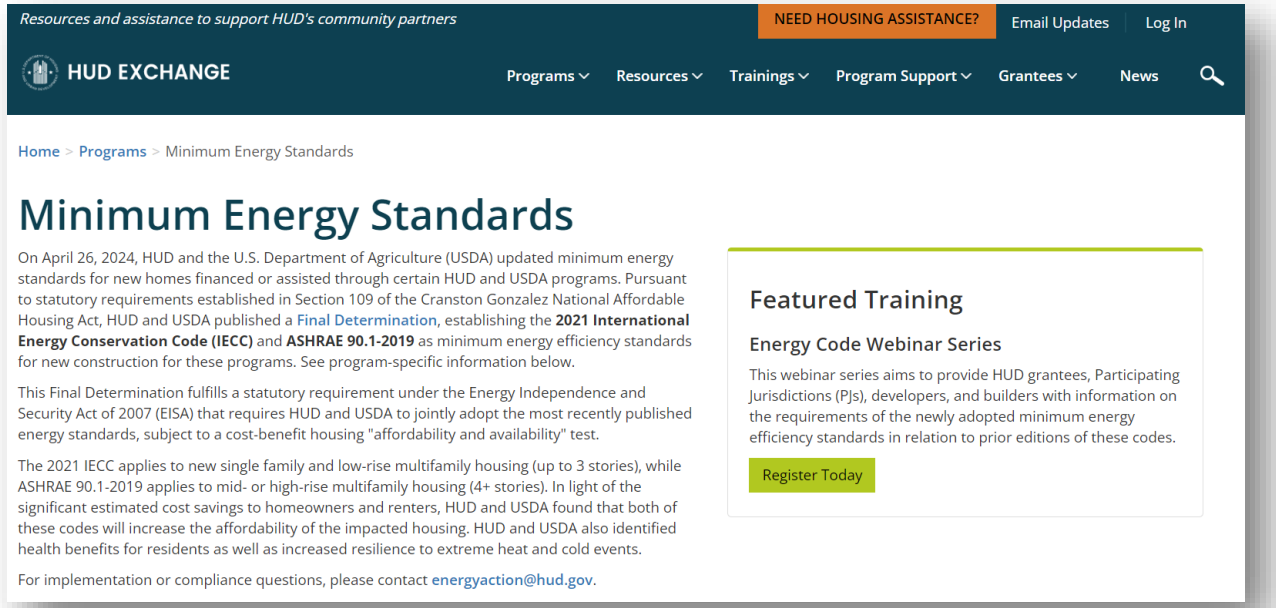
Differences in State Code Adoption and HUD Requirements

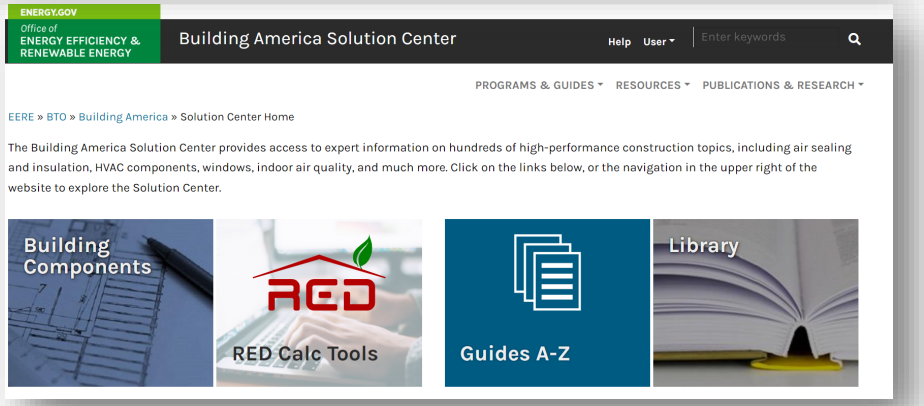
- Codes are adopted at the state or local level
- States often include amendments when adopting codes
- HUD- and USDA-financed new construction projects must build to the standards of the unamended ASHRAE 90.1-2019 or its equivalent performance level



Minimum Energy Standards Resources

- Introductory Code Resources
- Compliance Tools
- State-level Resources
- Technical Assistance Information
- Funding Opportunities
- Webinars and Recordings





https://www.hudexchange.info/programs/minimum-energy-standards/

ASHRAE 90.1-2019

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Comparison of ASHRAE 90.1-2007 to 2019

for New Construction Multifamily Housing

Paula M. Zimin, AIA
Senior Research Analyst

U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

PNNL-SA-206118

Introduction

- Reside in New Jersey
- Bachelor of Architecture, Virginia Tech
- Registered Architect in NJ and NY
- Specializing in Building Energy Performance for 17 years
- Boy-mom

Paula M. Zimin, AIA

Senior Research Analyst

Pacific Northwest National Lab

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Agenda

- **Background:** DOE Building Energy Codes Program
- **Review:** What are Energy Codes and HUD Minimum Energy Standards
- **ASHRAE 90.1 Overview:** Changes in Organization, Scope, Compliance paths and requirements
- **ASHRAE 90.1 Technical Updates:** Significant energy efficiency changes by Section, *specific to mid-rise and/or high-rise multifamily or mixed-use buildings*

DISCLAIMER: This presentation is not a comprehensive comparison of ASHRAE 90.1-2007 to ASHRAE 90.1-2019.

- **Resources & Appendix with additional comparison slides**

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DOE Building Energy Codes Program

Mission

To support building **energy code development, adoption, and implementation** to achieve the maximum practicable, cost-effective improvements in energy efficiency while providing safe, affordable, and healthy buildings for occupants.

Directive

The Building Energy Codes Program is directed to:

- **Participate in industry processes** to develop model building energy codes
- **Issue determinations** as to whether updated codes result in energy savings
- **Promulgate standards** for federal buildings
- **Provide technical assistance** to states and jurisdictions to implement their energy codes

More Information: www.energycodes.gov

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What are Energy Codes?

- Energy codes set requirements for minimum levels of efficiency for buildings and homes.
- Energy code is adopted by states and/or individual jurisdictions similar to other building codes.
- ASHRAE 90.1 and the IECC are the two predominant model energy standard and code in US.
- An updated version for both are published every three years.

ENERGY-EFFICIENT CODES COALITION a project of IMT INSTITUTE FOR MARKET TRANSFORMATION

How Energy Codes Affect You

Energy codes govern the efficiency of the lighting, walls, and systems that surround where you live and work. A space built to a more efficient energy code increases comfort and results in lower energy bills for your home and business.

Dimmers, daylight, and occupancy controls help to provide lights when you need them, and to save energy when you don't.

Energy-efficient windows let daylight and views in while minimizing heat gain from the sun.

Programmable thermostats and other control systems can help automatically lower costs when the space is empty.

Increased insulation and tighter construction reduce energy needs and help you stay warm or cool in the event of a power outage.

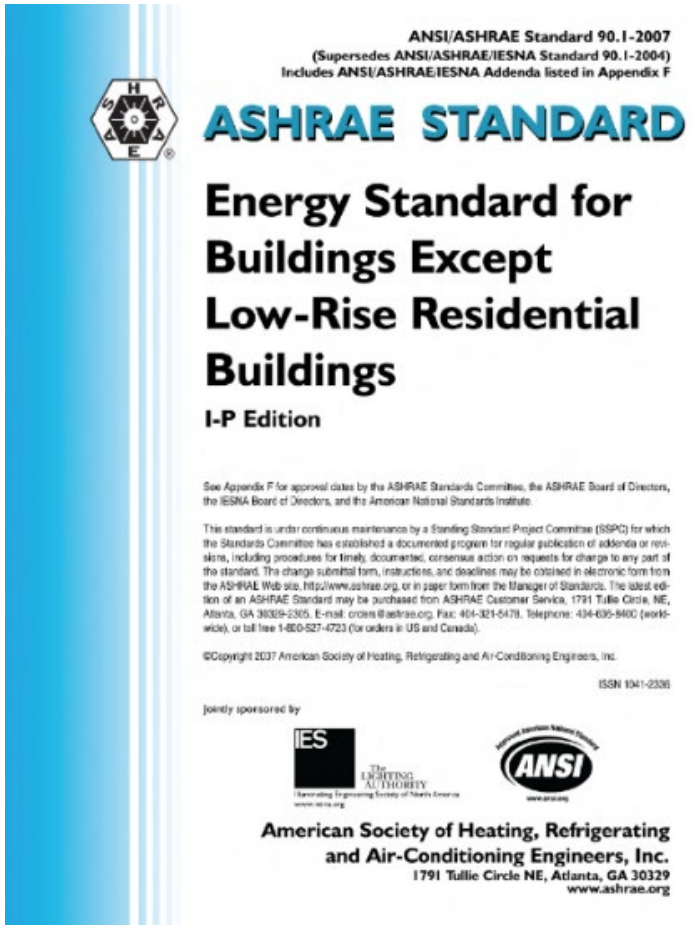
Properly-sized mechanical equipment reduces first costs and runs more efficiently, maintaining comfortable temperatures and humidity levels in the space.

High efficacy lights like LEDs use less energy and last years longer than incandescents, with LEDs lasting 25-30,000 hours compared to 1,000 for an incandescent.

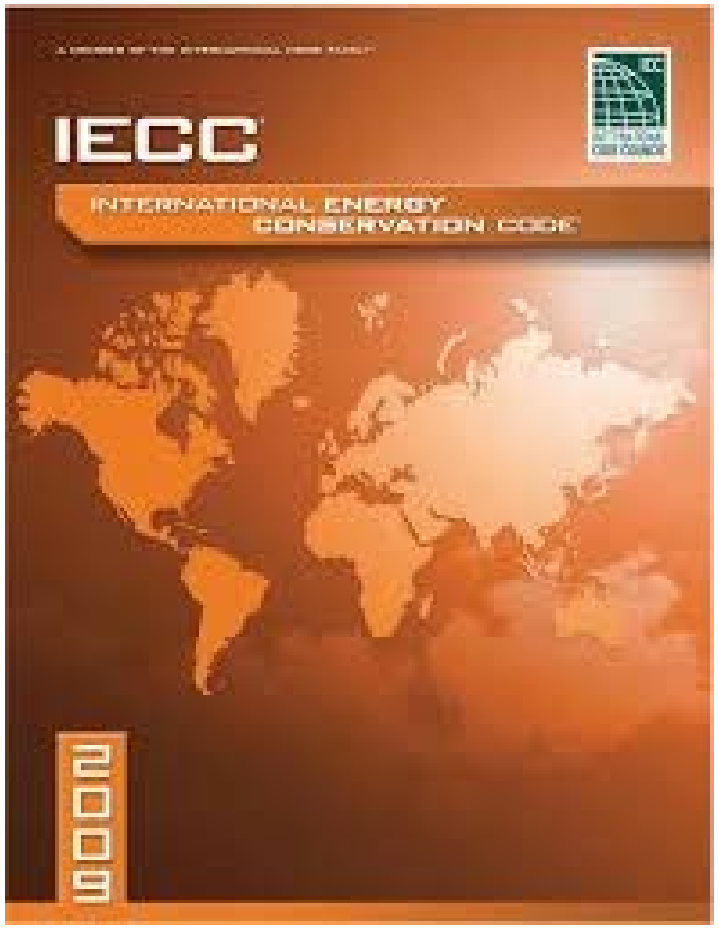
Proper sealing around the windows and doors reduces drafts and makes rooms more comfortable.

Well-insulated hot water piping reduces heat loss and helps you get hot water faster.

HUD Minimum Energy Standard for Multifamily (4+ stories) (OLD)



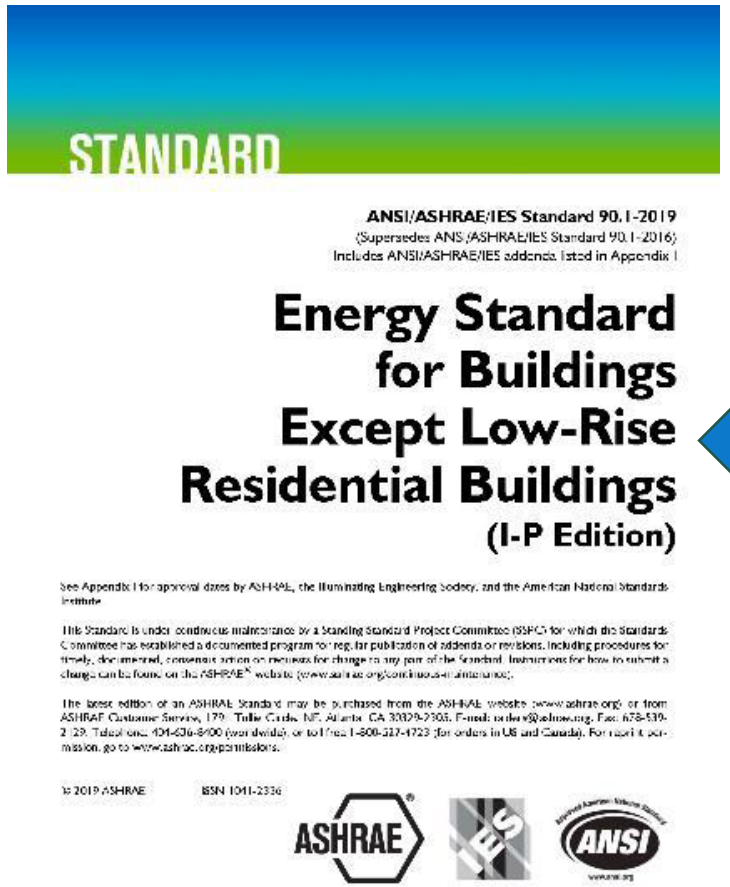
Partners!



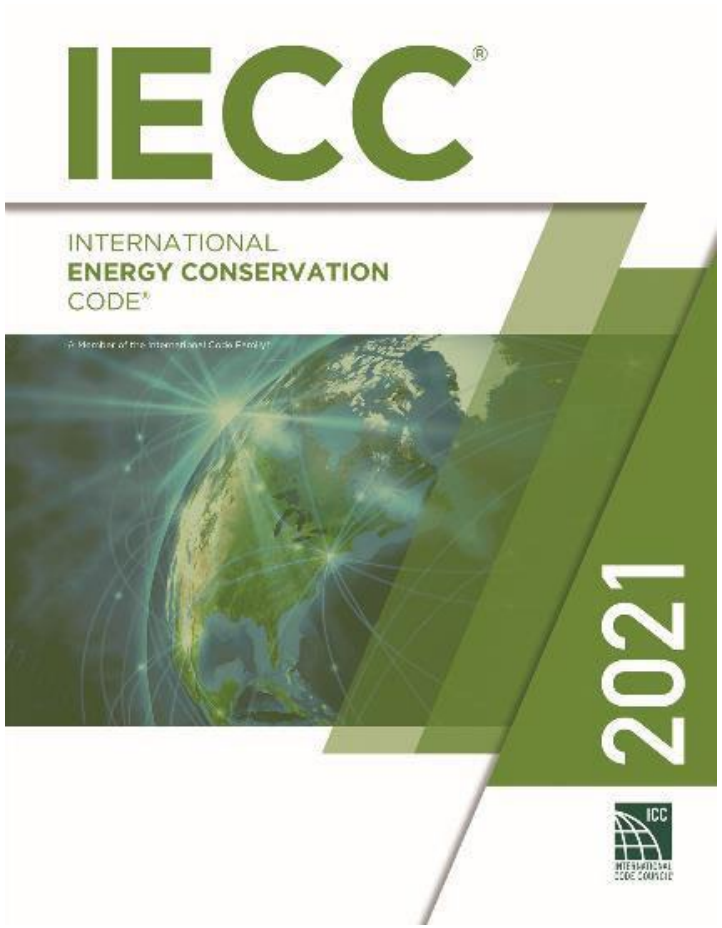
ASHRAE 90.1-2007

2009 IECC Commercial Provisions

HUD Minimum Energy Standard for Multifamily (4+ stories) (NEW)



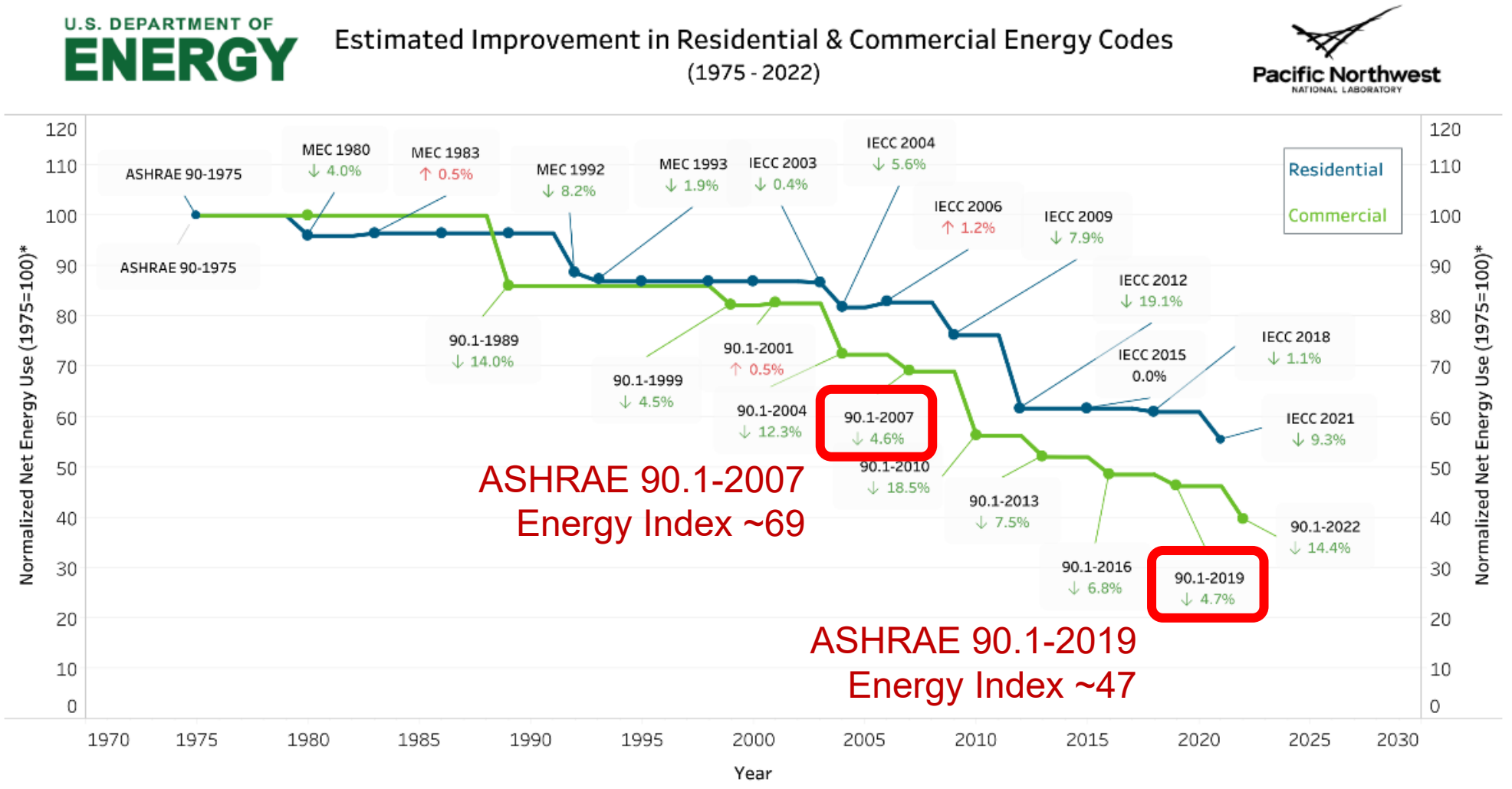
Partners!



ASHRAE 90.1-2019

2021 IECC
Commercial Provisions

Energy Code Incremental Changes



*Net energy use includes the contribution of renewable energy generation

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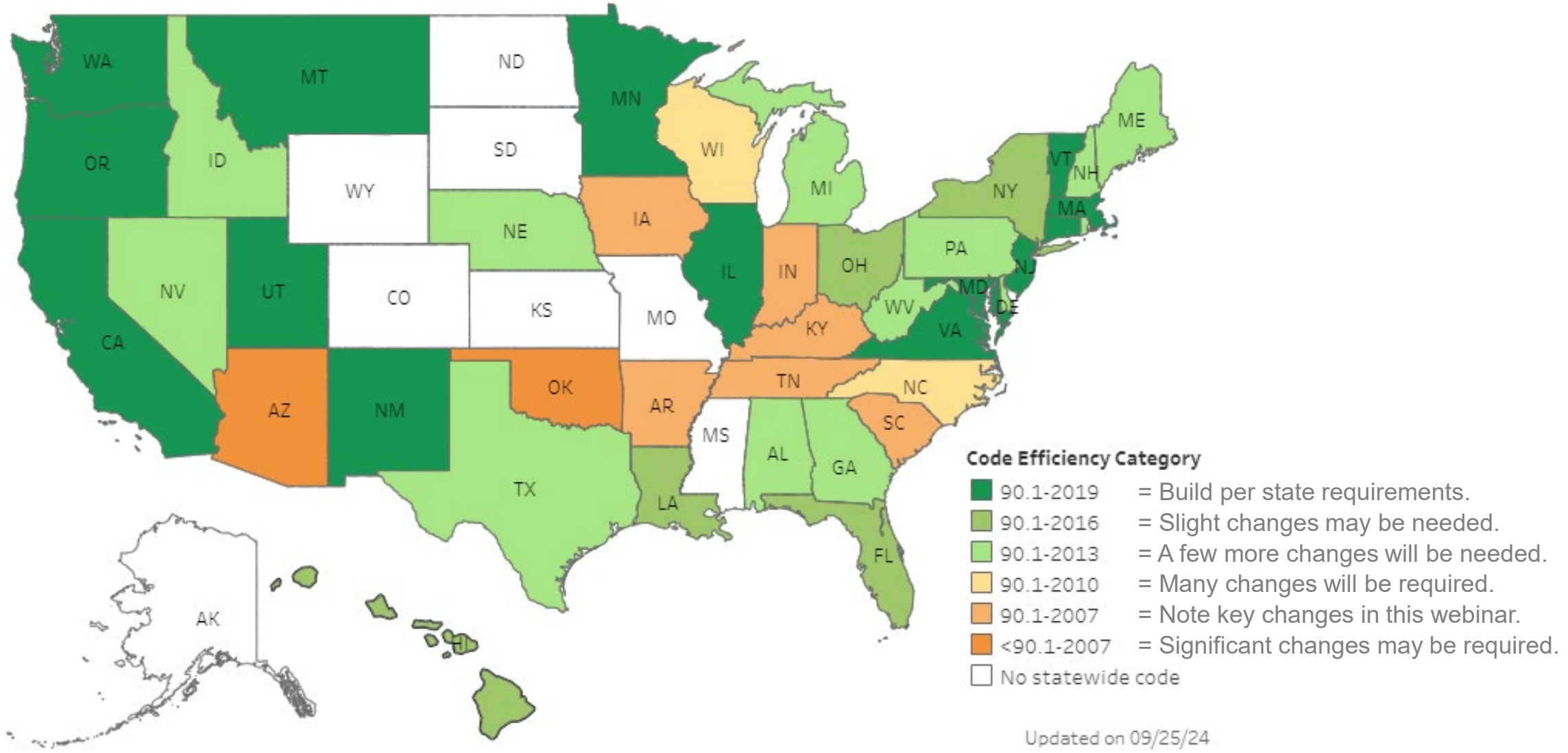
Commercial Energy Code Efficiency Category by State



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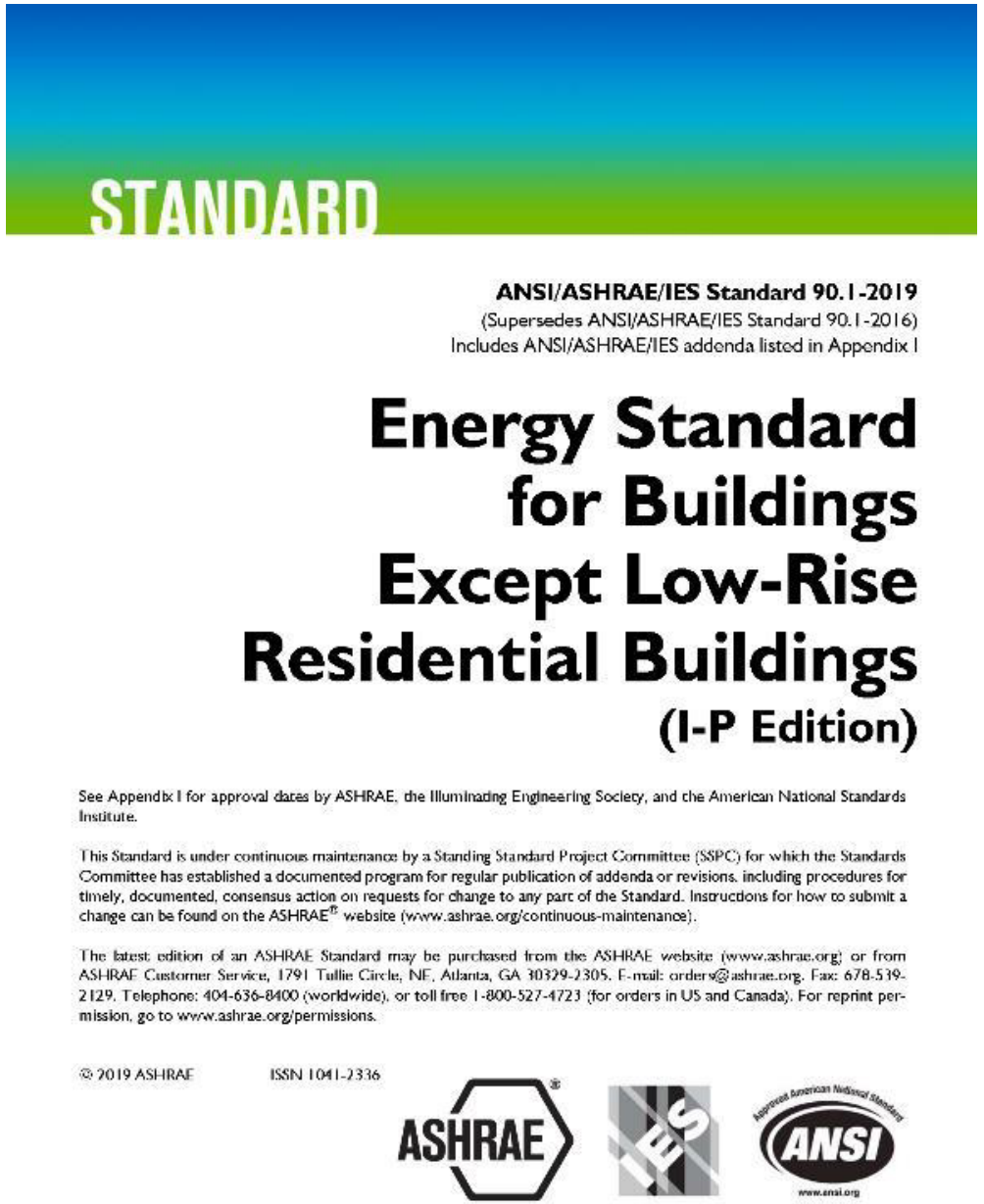
ASHRAE 90.1-2019 Overview

- Section organization
- Appendices
- Scope and application
- Compliance paths
- Compliance requirements



STANDARD

ANSI/ASHRAE/IES Standard 90.1-2019
(Supersedes ANSI/ASHRAE/IES Standard 90.1-2016)
Includes ANSI/ASHRAE/IES addenda listed in Appendix I

Energy Standard for Buildings Except Low-Rise Residential Buildings
(I-P Edition)

See Appendix I for approval dates by ASHRAE, the Illuminating Engineering Society, and the American National Standards Institute.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

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ASHRAE IES ANSI

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★ New Requirement

Presentation Key

- Blue text highlights slight changes to be noted, although general intent of code requirement remains unchanged,
- Requirements in orange text are notable changes in ASHRAE 90.1-2019 relative to 2007, where the code intent changes / expands,

- New code sections will be highlighted with an orange box with ★ New Requirement in upper left corner of slide.

No Change in Section Organization

ASHRAE 90.1-2019 (same as 2007)

Section 1 – Purpose

Section 2 – Scope

Section 3 – Definitions, Abbreviations, and Acronyms

Section 4 – Administration and Enforcement

Section 5 – Building Envelope

Section 6 – Heating, Ventilating, and Air Conditioning

Section 7 – Service Water Heating

Section 8 – Power

Section 9 – Lighting

Section 10 – Other Equipment

System Sections

Section 11 – Energy Cost Budget Method

Section 12 – Normative References

Organizational Changes in Appendices

2007	ASHRAE 90.1-2019 Appendices
✓	Appendix A – Rated R-value of Insulation and U-, C-, and F-factor Determinations
	Appendix B – (retained for future use)
✓	Appendix C – Methodology for Building Envelope Trade-off Option
	Appendix D – (retained for future use)
✓	Appendix E – Informative References
	★ Appendix F – US DOE Minimum Efficiency Requirements
✓	Normative Appendix G – Performance Rating Method
	★ Appendix H – Additional Guidance for Verification, Testing, and Commissioning
✓(F)	Appendix I – Addenda Description Information
	Annex 1: Reference ASHRAE Standard 169 – Climate Data

Scope of ASHRAE 90.1

ASHRAE 90.1 minimum energy-efficiency requirements are defined for all buildings, including residential or mixed-use buildings, ***EXCEPT***:

- *single-family houses*
- *multifamily structures of three stories or fewer above grade,*
- *manufactured houses (mobile homes), and manufactured houses (modular)*

Detached Single Family
(up to 3-stories)

Attached Single Family
(up to 3-stories)

Multifamily
(up to 3-stories)

Mobile / Modular
Homes

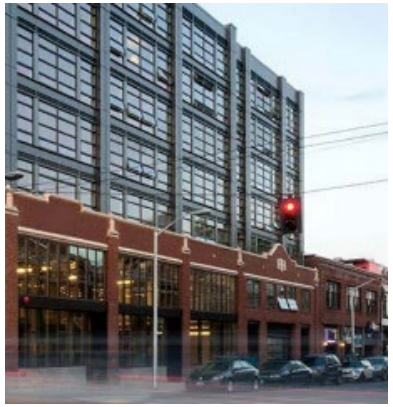
Scope of ASHRAE 90.1 (cont.)

ASHRAE 90.1 minimum energy-efficiency requirements apply to residential or mixed-use structures four stories and above:

- *multifamily structures of four stories or more above grade*

4 Story Multifamily

Townhomes
4+ stories



Mixed-Use
Multifamily / Retail

Mid- or High-Rise
Multifamily

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★ New

ASHRAE 90.1-2019 Compliance Summary

Compliance: Enter at Section 4.2.1 Compliance

Compliance Requirements at System Level
Section 5.2, 6.2, 7.2, 8.2, 9.2, 10.2, 11.2

Comply with all Mandatory Provisions
Section 5.4, 6.4, 7.4, 8.4, 9.4, 10.4, 11.4

Choose **One** Compliance Path!

Prescriptive:
Section 5.5, 6.5, 7.5, (9.5 or 9.6)

Performance:
Section 11
Energy Cost Budget

Performance:
Appendix G
Performance Rating Method

Documentation, Labeling, Inspections,
Verification, Testing, & Commissioning
Section 4.2.2, 4.2.3, 4.2.4, and 4.2.5

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Updates to Appendix G

Performance Rating Method

Appendix G is a recognized compliance path for ASHRAE 90.1-2019.

Energy credit is now given for the following design conditions:

- Optimized orientation
- Right sizing of HVAC equipment
- Optimized use of thermal mass
- Optimized fenestration and daylighting design
- Natural ventilation and other passive conditioning strategies
- Reduced fan power
- Optimized selection of HVAC and service water heating system types

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★ New

New Verification, Testing, and Commissioning Requirements Section 4.2.5

- Each building system section identifies specific requirements for verification, testing and commissioning (5.9.1, 6.9.1, 7.9.1, 8.9.1, 9.9.1, and 10.9.1)
- Each Performance Path option also lists verification, testing, and commissioning requirements (11.2(d) and G1.2.1(c))
- Verification and Testing provider must be identified in permit application.
- Verification and Testing provider must review drawings prior to permit application to confirm appropriate equipment is specified and proper maintenance clearance is provided for all applicable equipment.
- Verification and Testing report as well as Functional Performance Testing results must be provided to Owner or Owner's Representative.

New Compliance Documentation Requirements

Section 4.2.2.3 Manuals

- Regardless of which compliance path, ASHRAE 90.1-2019 explicitly requires the following documentation:
  - Operation and maintenance (O&M) manuals for each building system regulated by the standard. The manuals should meet industry standards as identified by references specific for each section identified in Appendix E. O&M manual requirements are required as defined in each of the following sections:
    - **Section 5.7.3.2 – Building envelope system and components**

      Section 6.7.3.2 – HVAC system and components
    - **Section 7.7.3.2 – Service Water Heating system and components**

      Section 8.7.3.2 – Power system and components
    - **Section 9.7.3.2 – Lighting system and components, and**
    - **Section 10.7.3.2 – Other systems.**

System Requirements Updates - Highlights

Section 5 - Building Envelope

- **Continuous Air Barrier and Leakage Testing**
- **Vestibules requirement**
- Prescriptive R-value/U-factors

Section 6 - HVAC

- **Ventilation Design Requirements**
- **Energy Recovery Ventilation**
- **Vestibule Heating and Cooling Limits**
- Parking Garage Ventilation
- Updated Insulation for Ducts and Piping
- Load Calculations
- Pumps, Fans, and Motors Sizing
- Equipment efficiencies Updates

Section 7 – Service Water Heating

- **Pipe insulation requirements**
- Equipment efficiencies

Section 8 – Power

- **Energy Monitoring and Reporting**

Section 9 – Lighting

- **Dwelling Unit Lighting**
- **Interior lighting and lighting controls**
- Exterior lighting power – new framework

Section 10 – Other Equipment

- **Elevator lighting and ventilation**
- Water pressure booster pumps controls
- Electric Motors: Motor efficiency requirements have updated

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Technical Updates Section 5 – Building Envelope

Defines building envelope performance requirements for insulation of walls, roofs, and floors, and thermal and solar performance of windows. Also defines weather protection requirements and air-sealing / air-leakage requirements.

Credit SOMA Studio and Family Apartments
Tenderloin Neighborhood Development Corporation

Section 5.4 – Mandatory Provisions

Section 5 – Building Envelope

5.4.3 – Air Leakage

5.4.3.1 – Continuous Air Barrier (previously “Building Envelope Sealing”)

5.4.3.2 – Loading Dock Weatherseals

5.4.3.3 – Vestibules

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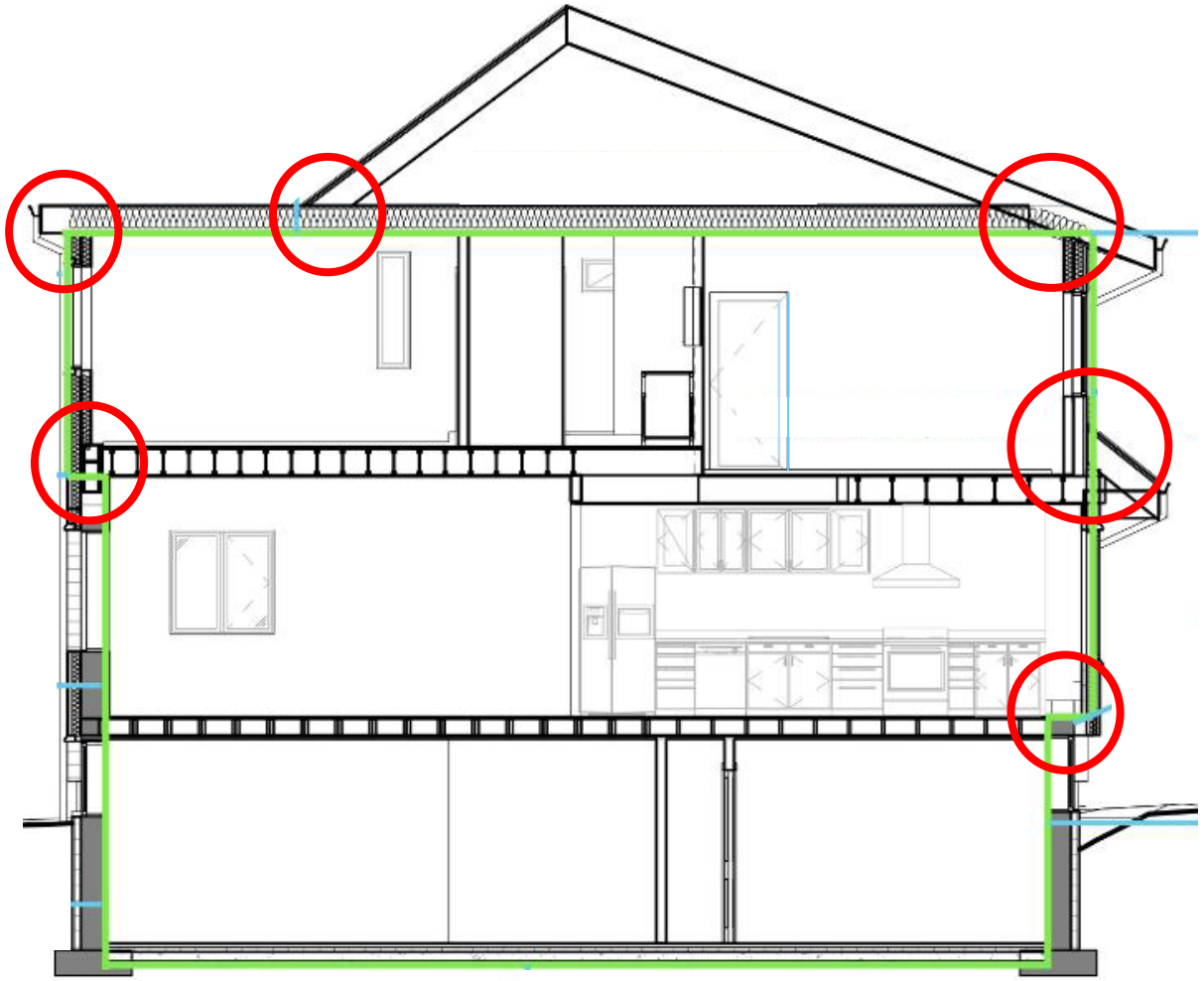
★ New Requirement

Continuous Air Barrier Section 5.4.3.1

- Requires **specific air barrier component** in each building assembly
- The air barrier is a system of materials and components which change at each intersection across the building envelope.
- No one material can be relied upon to be “the air barrier.”

Example Building Section



Credit: https://greeninghomes.com

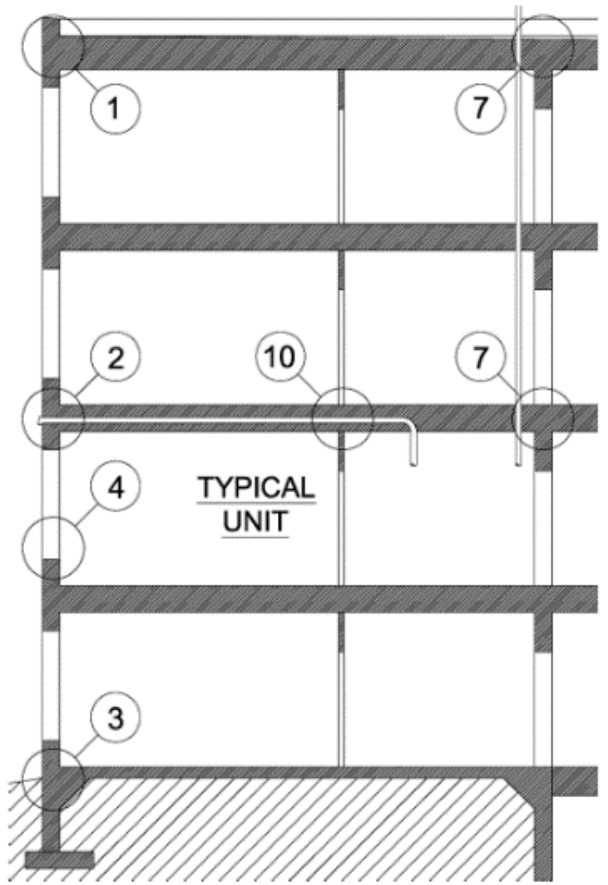
Continuous Air Barrier – Design and Installation

Section 5.4.3.1.2

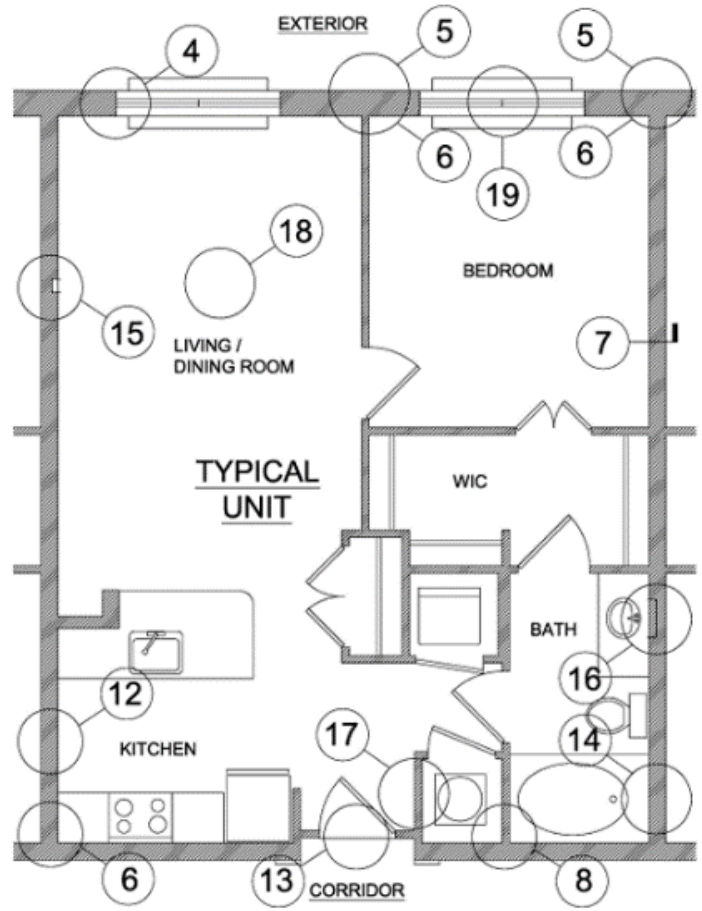
ASHRAE 90.1 2019
(similar to 2007 prescriptive requirements)

e. The following areas of the *continuous air barrier* in the *building envelope* shall be wrapped, sealed, caulked, gasketed, or taped in an approved manner to minimize air leakage:

1. Joints around *fenestration* and *door* frames
2. Junctions between *walls* and *floors*, between *walls* at *building* corners, and between *walls* and *roofs*
3. Penetrations through the *continuous air barrier* in *building envelope roofs*, *walls*, and *floors*
4. *Building* assemblies used as ducts or plenums
5. Joints, seams, connections between planes, and other changes in *continuous air barrier* materials



SECTION KEY
TYPICAL MULTIFAMILY BUILDING



PLAN KEY
TYPICAL UNIT PLAN

Credit: Steven Winter Associates, Inc.
https://www.swinter.com/about-us/news/news-item/air-sealing-guides/

★ New Requirement

Whole Building Air Leakage

Section 5.4.3.1.1

- The Continuous Air Barrier must be tested to confirm system performance. This is required on all buildings in all climate zones.
- Testing is done with a “Whole building pressurization test” using “blower door” equipment.
- In buildings larger than 50,000 sf, partial building testing (i.e. floor by floor) is permitted. HUD accepts compartmentalization testing in accordance with ENERGY STAR Multifamily guidelines.
- Verification of the design and installation of the continuous air barrier must be confirmed by an independent third party.

★ New Requirement

Air Leakage Testing

Section 5.4.3.1.1

3rd Parties:

Envelope and Building Energy Consultants

HERS Energy Raters

Air Barrier Association of America

Unit-by-Unit, or Compartmentalization Testing

Whole Building Testing

Section 5.4.3.3 – Vestibules and Revolving Doors

Section 5 – Building Envelope

Vestibules **and/or revolving doors** are required at building entrances. Building entrances include any doorway, set of *doors*, revolving *door*, vestibule, or other form of portal that is **ordinarily** used to gain access to the *building* or to exit from the *building* by its users and occupants.

Key changes for mid-rise or high-rise multifamily buildings:

- Vestibules or Revolving Doors are required on building entrances in **ALL climate zones**.
  - Entrance doors from street
  - Entrance from parking lot or courtyard area
  - Entrance from parking garage
- Some exceptions defined only apply to the air barrier requirements of vestibules. These are not commonly applicable to mid- or high-rise multifamily buildings.

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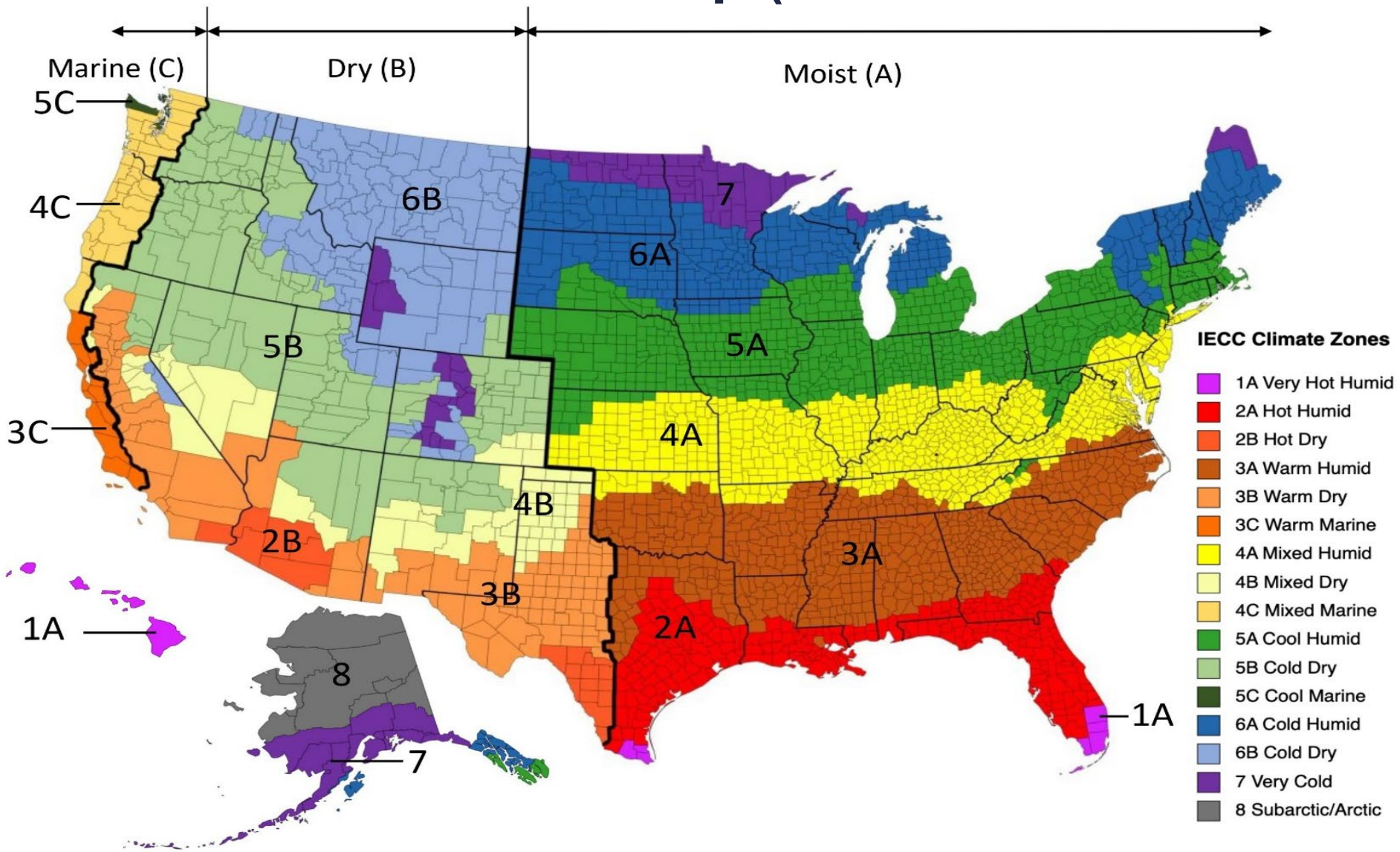
For Thermal Requirement Updates - U.S. Climate Zone Map (ASHRAE Standard 169)



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Section 5 – Building Envelope

Section 5.5 – Prescriptive Insulation Requirements

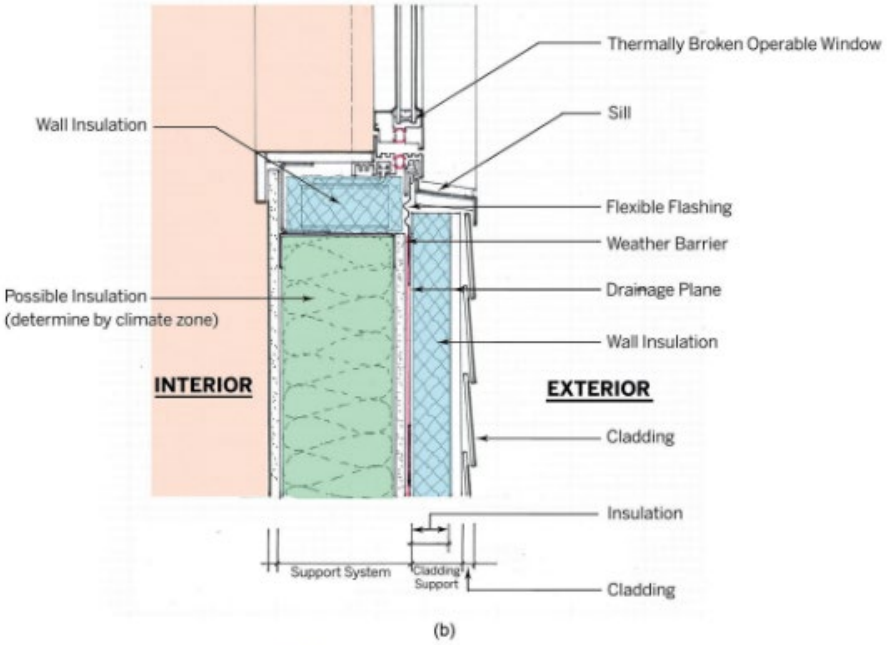

Figure 5-20 (EN36) Window System to Opaque Wall Connection: (a) Plan at Jamb and (b) Section at Sill
Figure Created by Keith Boswell, FAIA

Residential Fenestration / Window Assembly U-factor (0-40% WWR)

Climate Zone	90.1-2007*	90.1-2019**
	Per framing material	**Per operationality**
0, 1	1.2 (all)	**0.50 – 0.62**
2	0.70 – 0.75	**0.45 – 0.60**
3	0.60 – 0.65	**0.42 – 0.54**
4	0.40 – 0.55	**0.36 – 0.45**
5	0.35 – 0.55	**0.36 – 0.45**
6	0.35 – 0.55	**0.34 – 0.42**
7	0.35 – 0.45	**0.29 – 0.36**
8	0.35 – 0.45	**0.26 – 0.32**

* U-value ranges exclude entrance door performance requirement.
** Lower U-value reflects fixed window performance requirement; higher U-value reflects operable window performance

Image: ASHRAE Energy Design Guide for Zero Energy Multifamily

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★ New Requirement

Section 5 – Building Envelope

Section 5.5 – Prescriptive Insulation Requirements

- Tables 5.5.5.0-8 define maximum fenestration to gross wall area ratio is 40%
- ★ Section 5.5.4.5 puts additional limitation of fenestration area allowed on east- and west-oriented fenestration.

Potentially impacts urban infill the most:

- Prescriptively, no more than 25% of area of the east or west facades can be fenestration area.
- Area allowance adjustments with reduced SHGCs

Image Credit: MAP Architects

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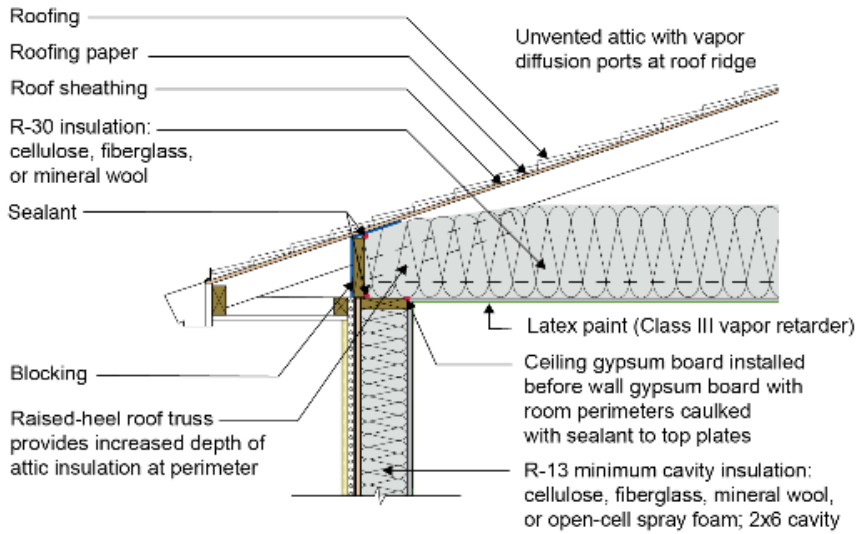
Section 5 – Building Envelope (

Section 5.5 – Prescriptive Insulation Requirements



Attic and Other R-value

Climate Zone	90.1-2007	90.1-2019
0	NA	**38**
1	38	38
2	38	38
3	38	38
4	38	**49**
5	38	**49**
6	38	**49**
7	38	**60**
8	49	**60**

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Section 5 – Building Envelope (2)

Section 5.5 – Prescriptive Insulation Requirements

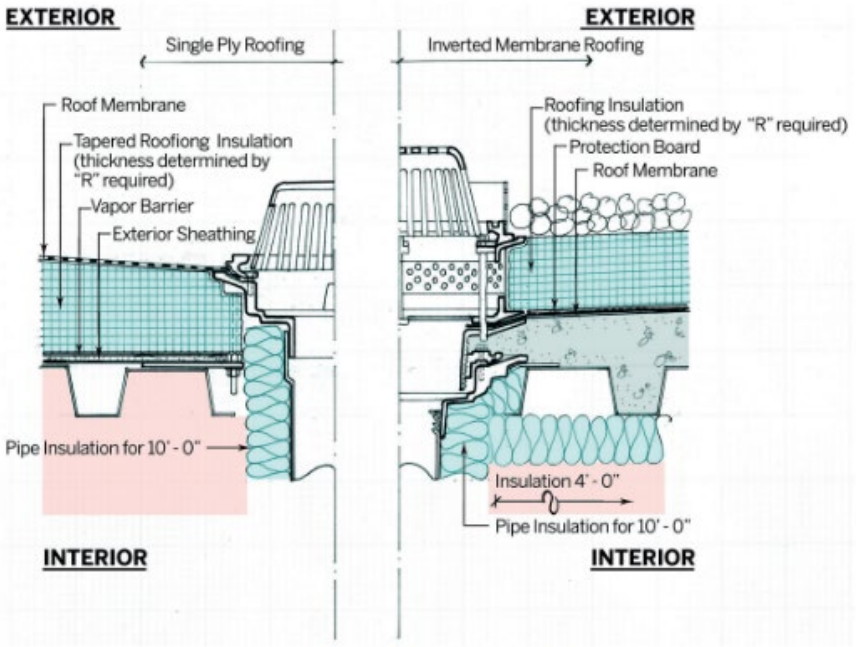

Figure 5-8 (EN30) Roof Drain Insulation
Figure Created by Keith Boswell, FAIA

Insulation Entirely Above Deck Roof R-value

Climate Zone	90.1-2007	90.1-2019
0	NA	**30 c.i.**
1	20 c.i.	**25 c.i.**
2	20 c.i.	**25 c.i.**
3	20 c.i.	**25 c.i.**
4	20 c.i.	**30 c.i.**
5	20 c.i.	**30 c.i.**
6	20 c.i.	**30 c.i.**
7	20 c.i.	**35 c.i.**
8	20 c.i.	**35 c.i.**

*c.i. = continuous insulation

Image: ASHRAE Energy Design Guide for Zero Energy Multifamily

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Section 5 – Building Envelope (3)

Section 5.5 – Prescriptive Insulation Requirements

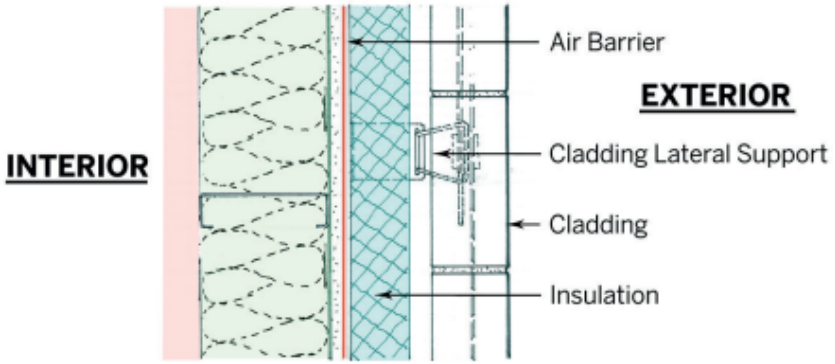

Figure 5-15 (EN34) Wall Masonry Attachment—Cladding Lateral Support
Figure Created by Keith Boswell, FAIA

Wood Frame Wall R-value

Climate Zone	90.1-2007	90.1-2019
0	NA	**R-13**
1	R-13	**R-13**
2	R-13	**R-13**
3	R-13	**R-13 + R-3.8 c.i., OR R-20**
4	R-13.0 + R-3.8 c.i.	**R-13 + R-3.8 c.i., OR R-20**
5, 6, and 7	R-13.0 + R-7.5 c.i.	**R-13 + R-7.5 c.i., OR R-19 + R-5 c.i.**
8	R-13.0 + R-15.6 c.i.	**R-13 + R-18.8 c.i.**

*c.i. = continuous insulation, most commonly installed outboard of the framing / exterior sheathing.

Image: ASHRAE Energy Design Guide for Zero Energy Multifamily

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Section 5 – Building Envelope (4)

Section 5.5 – Prescriptive Insulation Requirements

Closed Cell Spray Foam with spray applied cementitious fireproofing layer
Credit: Building Science Corporation
https://buildingscience.com/documents/building-science-insights-newsletters/bsi-124-parking-garages

Mass Floor R-value (above parking)

Climate Zone	90.1-2007	90.1-2019
0	NA	NR
1	NR	NR
2	8.3 c.i.	8.3 c.i.
3	8.3 c.i.	**10 c.i.**
4	10.4 c.i.	**16.7 c.i.**
5	12.5 c.i.	**16.7 c.i.**
6	14.6 c.i.	**16.7 c.i.**
7	16.7 c.i.	**20.9 c.i.**
8	16.7 c.i.	**23 c.i.**

*c.i. = continuous insulation

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Technical Updates Section 6 – HVAC

Covers mechanical equipment and systems serving heating, cooling, ventilation and refrigeration services

Section 6 – HVAC

Key Updates Applicable to Typical Multifamily New Construction

- **6.5.3.7 – Ventilation Design requirements**
- **6.5.6.1 – Energy Recovery Ventilation requirements**
- **6.4.3.9 – Vestibule heating and cooling**
- **Minimum equipment efficiencies updated**
  - Added Variable Refrigerant Flow (VRF) equipment
  - High-capacity boiler system efficiency requirements
  - Added refrigeration equipment

See Appendix for updates related to:

- 6.4.3.4.5 – Parking garage ventilation
- 6.4.4 – Insulation for ductwork and piping
- 6.4.2 – Load calcs and pump sizing requirements
- 6.5.3.1 and 6.5.3.6 – Efficiency requirements for fans and motors

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★ New Requirement

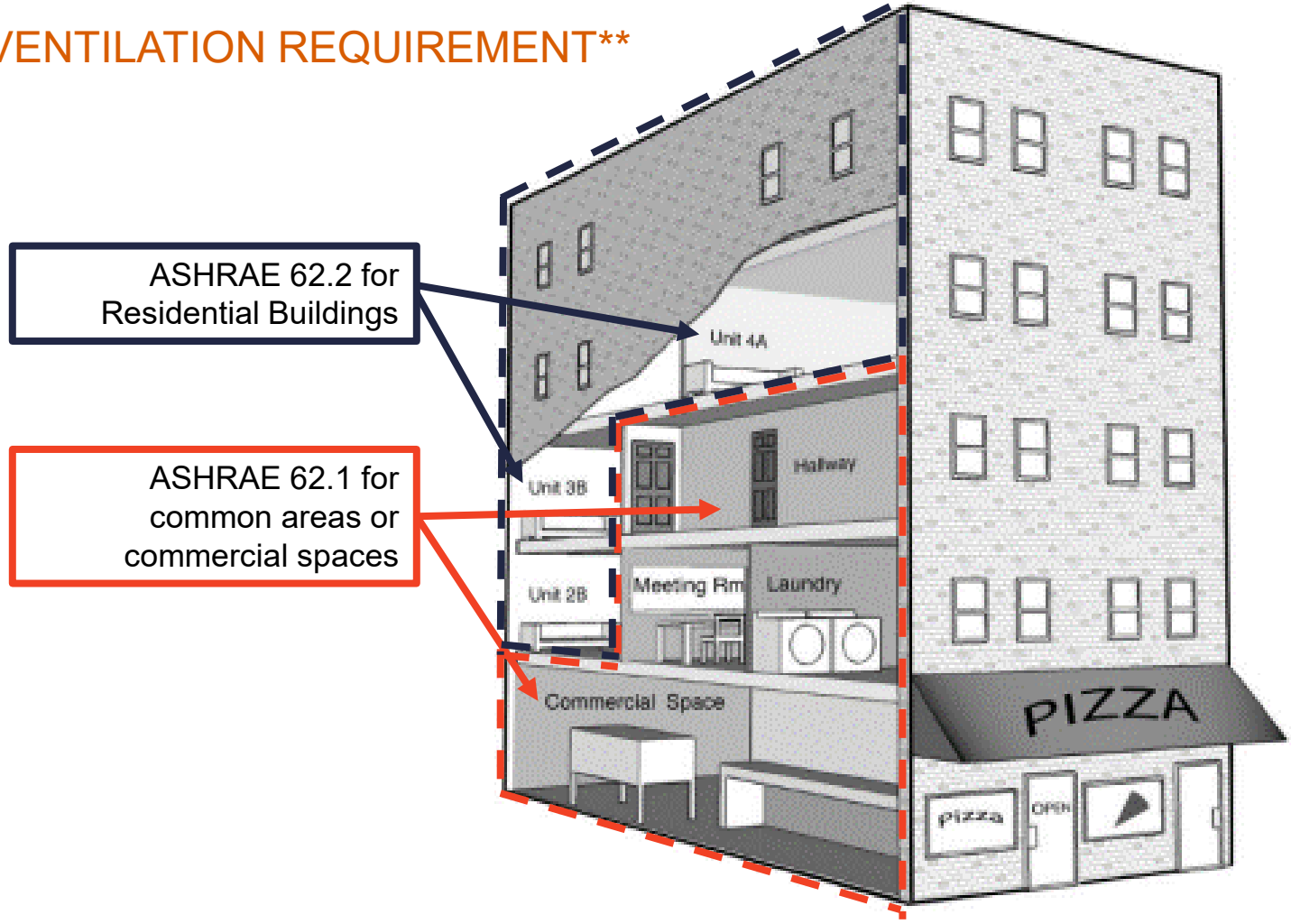
NEW MECHANICAL VENTILATION REQUIREMENT

Section 6 – HVAC
Ventilation Design

Requirements for Multifamily 6.5.3.7

Required minimum outdoor air rate is the larger of:

- **Standard 62.1** for common areas and commercial areas in mixed-use buildings, AND
- **Standard 62.2** for nontransient dwelling units. Requires vented kitchen range hood, make up air for dryers with exhaust, and mechanical outdoor air for each unit.



ASHRAE 62.2-2016 User Manual

★ New Requirement

Ventilation Design

Section 6.5.3.7

- Natural ventilation, as previously defined, is no longer a compliance pathway for ventilation of dwelling units in ASHRAE 62.2-2019. Mechanical ventilation is required in all dwelling units.

- Outdoor air ventilation systems shall comply with one of the following:
  - ❑ The system includes exhaust air energy recovery complying with Section 6.5.6.1.
  - ❑ Dampers, ductwork, and controls shall be provided that allow the system to supply no more than the required minimum outdoor air rate with a single set-point adjustment.
  - ❑ Design minimum system outdoor air provided shall not exceed 135% of the required minimum outdoor air rate.

★ New Requirement

Energy Recovery Ventilation Requirements

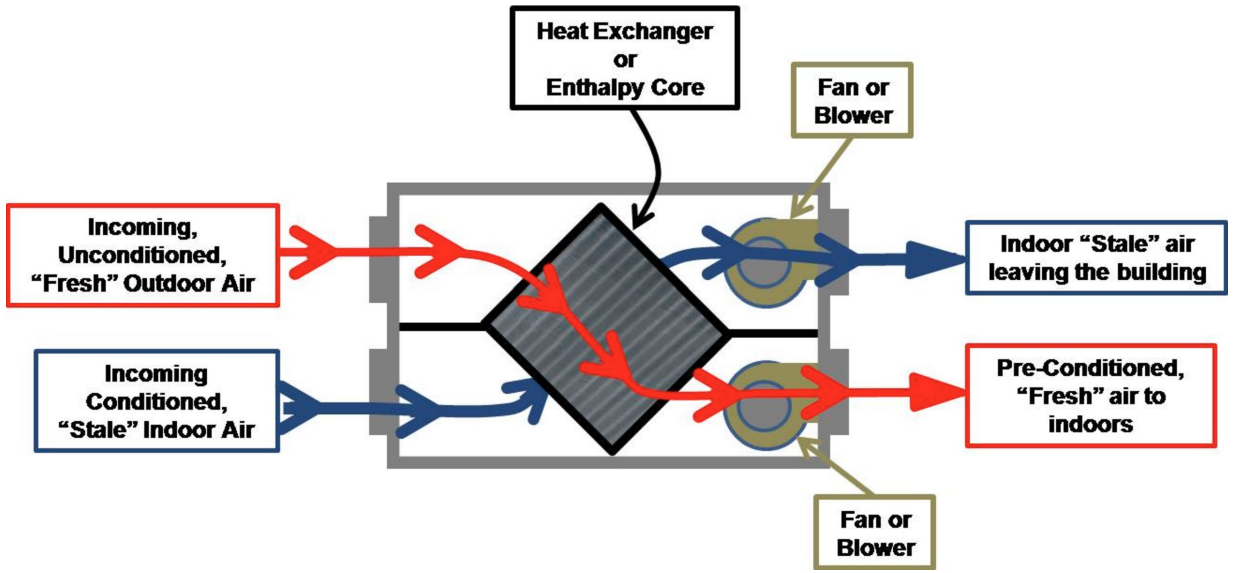
Section 6.5.6 – Energy Recovery

6.5.6.1.1 – Exhaust Air Energy Recovery for Nontransient Dwelling Units

ERVs are now required in dwelling units across all climate zones, except in:

- Climate Zone 3C, and
- Dwelling units less than 500 sf in Climate Zones 1, 2, 3A, 3B, 4C, and 5C.

System design can be unitary or centralized.



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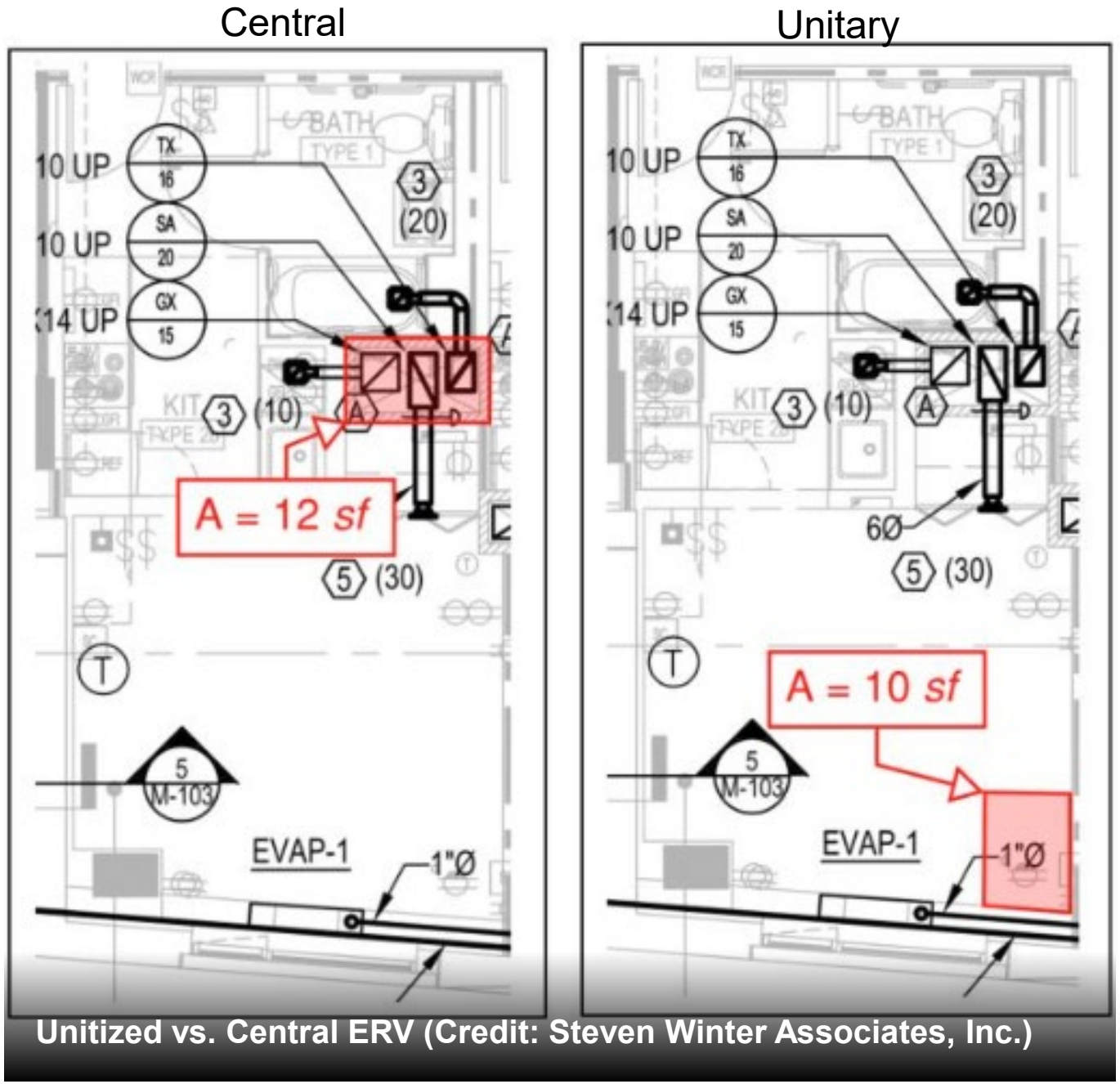
Design Options

Energy Recovery Ventilation

Factors to consider:

- Floor area impacts
- Electricity costs
- Maintenance costs



Unitized vs. Central ERV (Credit: Steven Winter Associates, Inc.)

★ New Requirement

Vestibule Heating and Cooling Controls

Section 6.4.3.9

Heated or Cooled Vestibules

- Heating: max 60°F set point, operational only below 45°F outdoor air temp
- Cooling: min 85°F set point

Exception to the above – heating or cooling provided by site-recovered energy or transfer air that would otherwise be exhausted.

Equipment Sizing and Efficiencies

Section 6 – HVAC

Unitary Design

Split System AC and Furnace

Equipment	90.1-2007	90.1-2019
Furnace	78% AFUE / 80% E_t	80% AFUE / 80% E_t
DX Cooling	13.0 SEER	13.4 SEER2*

Split System Heat Pump

Equipment	90.1-2007	90.1-2019
DX Heating	7.7 HSPF	7.5 HSPF2*
DX Cooling	13.0 SEER	14.3 SEER2*

Central System Design

PTAC with Central Gas Boiler

Equipment	90.1-2007	90.1-2019
Boiler	80% E_t	80% E_t
DX Cooling (efficiency varies based on capacity	9.3-11.0 EER	9.5 – 11.9 EER

WSHP with Central Gas Boiler

Equipment	90.1-2007	90.1-2019
Boiler	80% E_t	80% E_t
WSHP (efficiency varies based on capacity	11.2-12.0 EER 4.2 COP	12.2-13.0 EER 3.5 ISCOP*

*Efficiency rating based on new testing procedures, not a one-to-one comparison by value alone.

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Technical Updates Section 7 – Service Water Heating

- Minimal updates
  - Pipe insulation for central DHW / recirculating systems
  - Equipment Efficiencies

Credit: DOE ZERH Webinar: Efficient Hot Water Distribution in Zero Energy Ready Multifamily Buildings

Technical Updates – Section 7

Service Water Heating

Summary of changes:

Version	Changes in Section 7	Application
90.1-2010	No updates	
90.1-2013	New section (7.5.3) – buildings with high-capacity service water heating systems	Applies to centralized DHW systems with total installed gas water-heating input capacity of 1 Million Btuh or more. Minimum equipment thermal efficiency ≥ 90% Et
90.1-2016	(7.4.3) New requirement for insulation of the first 8 ft of branch piping connected to pipe that is heated by recirculating hot water, heat trace, or impedance heated pipe.	(see graphic next slide)
90.1-2019	Update to minimum performance requirements for service water heating equipment	Table 7.8 performance minimums align with federal minimum standards, also provided in Appendix E.

★ New Requirement

SWH Branch Pipe Insulation

Section 6 - Service Water Heating

- New insulation requirement for recirculation systems: Branch pipe insulation

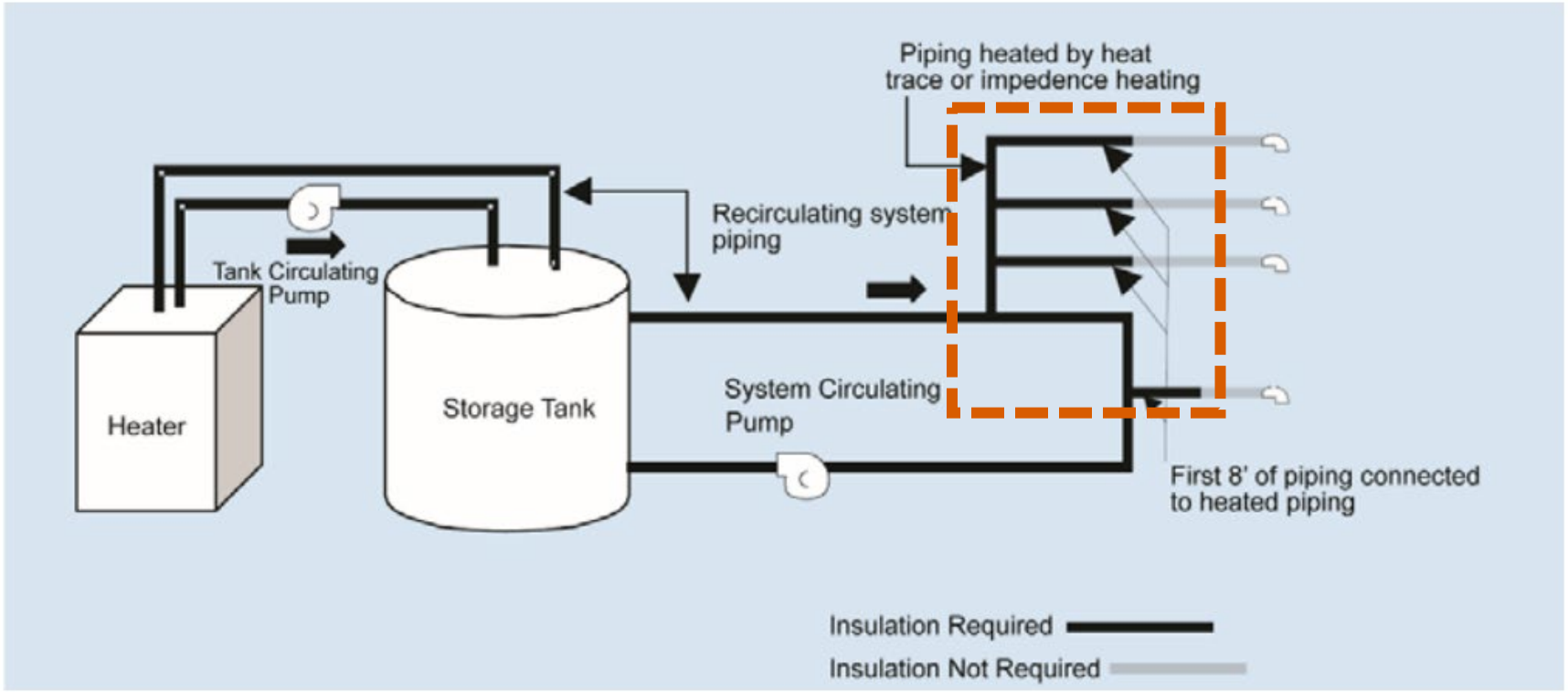

FIGURE 7-B. PIPE INSULATION REQUIREMENTS

Corresponding section: Service Hot-Water Piping Insulation (7.4.3)

Credit: ASHRAE 90.1-2016 User Manual

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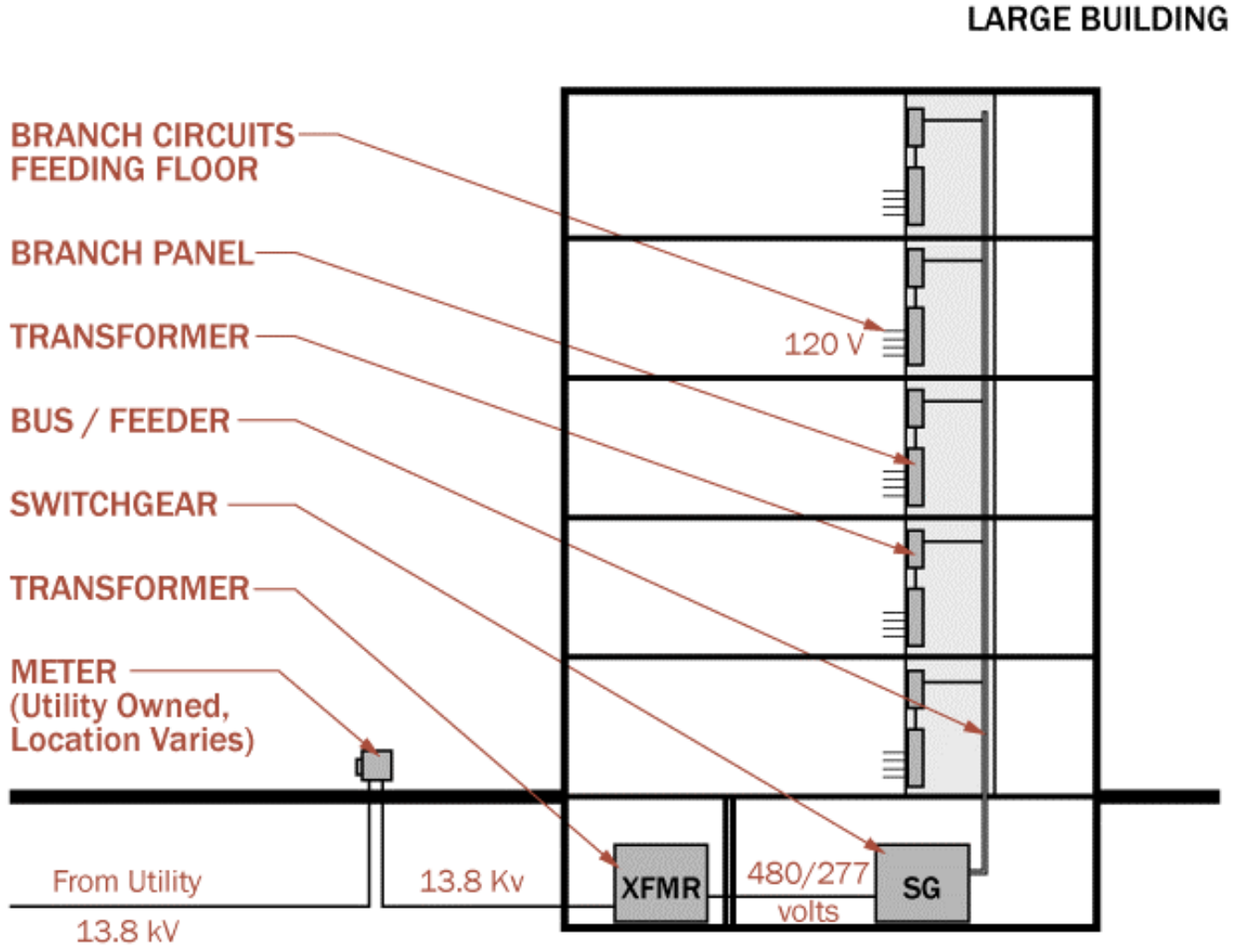
Technical Updates Section 8 – Power

- New performance requirements for dry-type transformers
- Modification to voltage drop requirement (5% combined)
- Automatic receptacle controls (business center)*
- ★ **Mandatory electrical use monitoring and recording**



Electrical Distribution in a Large Building

Credit: archtoolbox.com

★ New Requirement

Technical Updates – Section 8

Power

Electrical Energy Monitoring (8.4.3)

- 8.4.3.1 – Monitoring
  - Individual meters for each dwelling unit
  - ★ Common area separately metered for each major system
    - If common area is greater than 10,000 ft^2 , separate metering required for HVAC systems, interior lighting, exterior lighting, and receptacle circuits

- 8.4.3.2 – Recording and Reporting
  - For common areas greater than 10,000 ft^2: Energy use must be recorded in 15-minute intervals and be able to be reported in hourly, daily, monthly, and annual summaries.
  - In mixed-use buildings with retail / commercial tenant spaces greater than 10,000 ft^2: energy use reports must be provided to tenants
  - Multifamily buildings with digital control systems must have access to common area energy use data and be able to graphically display energy use. System must maintain data for at least 36 months.

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Technical Updates Section 9 – Lighting

- Dwelling unit lighting requirements
- Common Areas
  - Lower LPDs
  - Expanded control requirements
- New exterior lighting energy allowance framework

★ New Requirement

Interior Lighting Efficiency and Controls

Section 9 - Lighting

Space Type	Change	Technical Requirement
Dwelling Units (9.4.3)	Hard-wired dwelling unit lighting is now explicitly regulated by ASHRAE 90.1-2019	At least 75% of permanently installed lighting fixtures shall either use high efficacy lamps (>55lm/W) or have a total luminaire efficacy of >45lm/W
	90.1-2007	**90.1-2019**
Corridors	0.5 W/sf – no control requirements	0.41 W/sf – some control req'd*
Lobbies	1.3 W/sf – no control requirements	0.84 W/sf – some control req'd*
Stairs	0.6 W/sf – no control requirements	0.49 W/sf – some control req'd*
Parking Garages	0.2 W/sf – no control requirements	0.15 W/sf – controls per 9.4.1.2

*there may be some exceptions allowed based on population type or for security purposes

★ New Requirement

Exterior Lighting

Section 9 – Lighting

Ltg Zone	Zone Alias**	Description	Base Site Allowance	Tradeable Surface categories*	Nontradable Surface categories*
0	Dark Sky	Undeveloped areas within national parks, state parks, forest land, rural areas, and other undeveloped areas as defined by the authority having jurisdiction	Zero	Uncovered parking Building grounds Building entry/exits	Building facades
1	Rural	Developed areas of national parks, state parks, forest land, and rural areas	350 W		
2	Default	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed-use areas	400 W		
3	Bright	All other areas	500 W		
4	Times Sq / Vegas Strip	High-activity commercial districts in major metropolitan areas as designated by the local jurisdiction	900 W		

*categories most applicable to multifamily buildings
** not official zone name – suggested rule of thumb for multifamily but should be confirmed with local jurisdiction

- New exterior lighting allowance defined by lighting zones
- Exterior lighting power reduction control required for all pole-mounted luminaires serving outdoor parking lots with an input wattage >78W and mounting height <24 ft (9.4.1.4)

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Technical Updates Section 10 – Other Equipment

- Elevators
- Water pressure booster pumps
- Electric motors

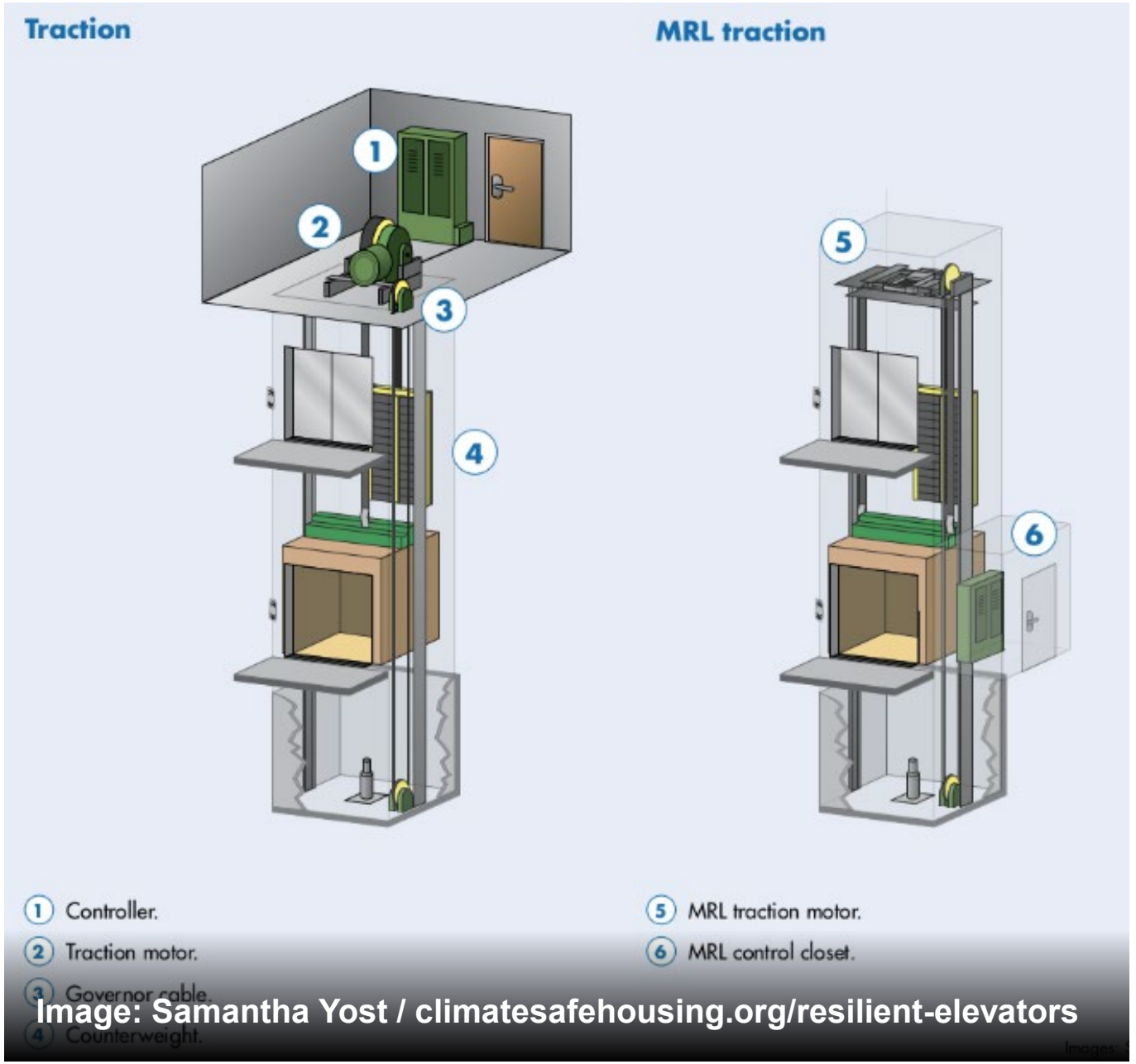

Image: Samantha Yost / climatesafehousing.org/resilient-elevators

★ New Requirement

Technical Updates – Section 10

Other Equipment

Section 10 Scope - covers elevators, services water pressure booster systems and electric motors.

- **Elevators:** ASHRAE 90.1-2019 now regulates elevator cab lighting and ventilation systems. Both systems must de-energize when in standby mode.
- **Water pressure booster pumps:** new requirements to achieve best efficiency point during operations.
- **Electric Motors:** Motor efficiency requirements have updated – reference standard for minimum motor efficiency tables changed from NEMA to DOE. Mostly will impact central ventilation fans or pumps.

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Summary

- **ASHRAE 90.1-2019 is the new HUD Minimum Energy Standard**
- There are three compliance pathways:
  - One (1) prescriptive path and
  - Two (2) performance pathways: Section 11 and Appendix G.
- Each compliance pathway also requires:

➢ **Operation and Maintenance manuals** for each building system as defined in sections 5.7.3.2, 6.7.3.2, 7.7.3.2, 8.7.3.2, 9.7.3.2, and 10.7.3.2.

➢ **Testing, Verification and Commissioning** of each building system, as defined in sections 5.9, 6.9, 7.9, 8.9, 9.9, and 10.9

System Requirements Updates - Review

Section 5 - Building Envelope

- **Continuous Air Barrier and Leakage Testing**
- **Vestibules requirement**
- Prescriptive R-value/U-factors

Section 6 - HVAC

- **Ventilation Design Requirements**
- **Energy Recovery Ventilation**
- **Vestibule Heating and Cooling Limits**
- Parking Garage Ventilation
- Updated Insulation for Ducts and Piping
- Load Calculations
- Pumps, Fans, and Motors Sizing
- Equipment efficiencies Updates

Section 7 – Service Water Heating

- **Pipe insulation requirements**
- Equipment efficiencies

Section 8 – Power

- **Energy Monitoring and Reporting**

Section 9 – Lighting

- **Dwelling Unit Lighting**
- **Interior lighting and lighting controls**
- Exterior lighting power allowance – new structure

Section 10 – Other Equipment

- **Elevator lighting and ventilation**
- Water pressure booster pumps controls
- Electric Motors: Motor efficiency requirements have updated

Resources (1 of 2)

ALL SYSTEMS AND MULTIFAMILY SPECIFIC

ASHRAE 90.1-2019 Read-only

https://ashrae.iwrapper.com/ASHRAE_PREVIEW_ONLY_STANDARDS/STD_90.1_2019

DOE Building Energy Code Training Hub

https://training.energycodes.gov/ui/

ASHRAE Advanced Energy Design Guides - Multifamily

www.ashrae.org/technical-resources/aedgs/zero-energy-aedg-free-download

Multifamily Guide – New Buildings Institute

www.newbuildings.org/product/multifamily-guide/

Building Energy Exchange Online Exhibit – Anatomy Systems

https://be-exchange.org/anatomy-systems

BUILDING ENVELOPE

Better Buildings Solution Center

https://betterbuildingssolutioncenter.energy.gov/building-envelope

Air Sealing Guides – Steven Winter Associates, Inc.

https://www.swinter.com/about-us/news/news-item/air-sealing-guides/

Green Building Advisor - Compartmentalization

https://www.greenbuildingadvisor.com/article/compartmentalization-in-multifamily-buildings

The Associated Air Balance Council Commissioning Group - New Energy Codes and Whole Building Airtightness Testing

https://www.youtube.com/watch?v=tTjgz7CNJXA

Building Science Corporation – Parking Garages

https://buildingscience.com/documents/building-science-insights-newsletters/bsi-124-parking-garages

Resources (2 of 2)

VENTILATION

NREL: Ventilation Guidance for Residential

https://research-hub.nrel.gov/en/publications/measure-guideline-ventilation-guidance-for-residential-high-perfo

Ventilation Design – Unitized or Central ERV

https://www.swinter.com/party-walls/multifamily-passive-house-ventilation-design-part-1-unitized-or-centralized-hrv-erv/

SERVICE HOT WATER

DOE ZERH Webinar: Efficient Hot Water Distribution in Zero Energy Ready Multifamily Buildings

https://www.energy.gov/eere/buildings/zerh-webinar-efficient-hot-water-distribution-zero-energy-ready-multifamily

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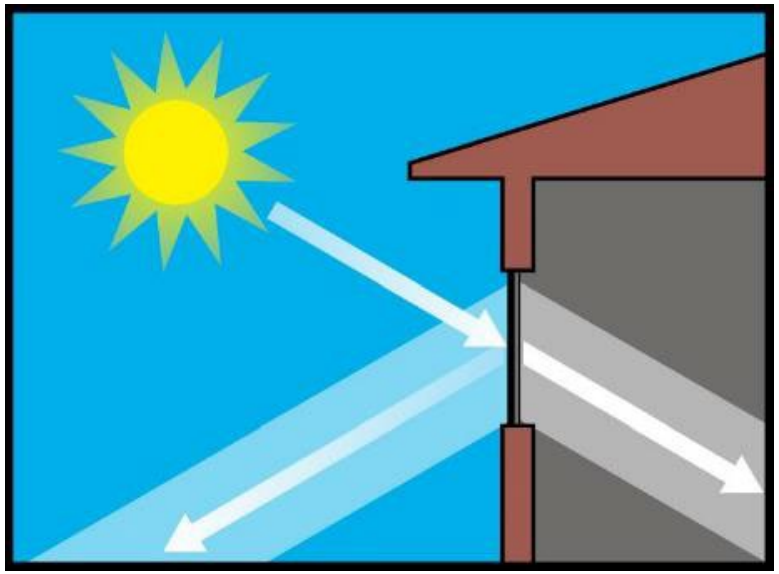
Section 5 – Building Envelope (5)

Section 5.5 – Prescriptive Insulation Requirements

Solar Heat Gain Coefficient (SHGC)



Residential Fenestration SHGC

Climate Zone	90.1-2007	90.1-2019
	One SHGC req't	SHGC range*
0	NA	**0.20 – 0.22**
1	0.25	**0.21 – 0.23**
2	0.25	**0.23 – 0.25**
3	0.25	**0.23 – 0.25**
4	0.40	**0.33 – 0.36**
5	0.40	**0.33 – 0.38**
6	0.40	**0.34 – 0.38**
7	NR	**0.36 – 0.40**
8	NR	**0.36 – 0.40**

* Lower SHGC value reflects operable window SHGC requirement; higher SHGC value reflects fixed window SHGC requirement

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Section 5 – Building Envelope (6)

Section 5.5 – Prescriptive Insulation Requirements

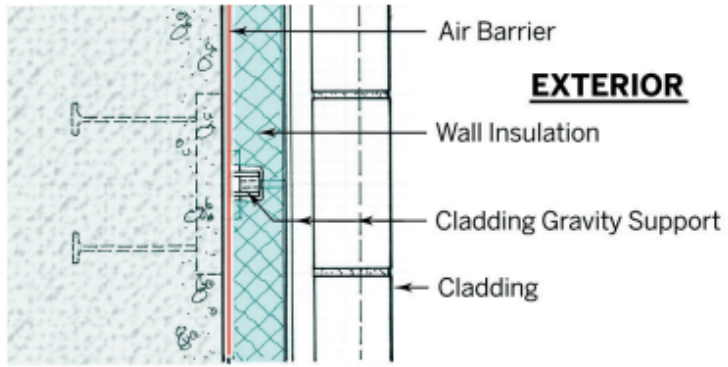

Figure 5-14 (EN34) Wall Masonry Attachment—Cladding Gravity Support
Figure Created by Keith Boswell, FAIA

Mass Wall R-value

Climate Zone	90.1-2007	90.1-2019
0	NA	**5.7 c.i.**
1	5.7 c.i.	**5.7 c.i.**
2	7.6 c.i.	**7.6 c.i.**
3	9.5 c.i.	**9.5 c.i.**
4	11.4 c.i.	**11.4 c.i.**
5	13.3 c.i.	**13.3 c.i.**
6	15.2 c.i.	**15.2 c.i.**
7	15.2 c.i.	**15.2 c.i.**
8	25 c.i.	**19 c.i.**

*c.i. = continuous insulation

Image: ASHRAE Energy Design Guide for Zero Energy Multifamily

★ New Requirement

Section 6 – HVAC

Parking Garage Ventilation

6.4.3.4.5 – Enclosed Parking Garage Ventilation

Stage garage ventilation fans or modulate fan airflow to 50% or less with automatic control system which detects contaminant levels in the following design scenarios:

- any garage which provides mechanical heating or cooling,
- parking garages over 30,000 ft^2, or
- parking garages with a garage area to ventilation system motor nameplate horsepower ratio that exceeds 1500 ft^2/hp

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Section 6 – HVAC

Ductwork and Piping Insulation Updates

6.4.4 – HVAC System Construction and Insulation

Heating-Only Ducts												
	Exterior			90.1-2007					90.1-2019*		Indirectly Conditioned Sp	
Climate Zone	90.1-2007	90.1-2019*		Ventilated Attic	Unvented Above Insulated Ceiling	Unvented with Roof Insulation	Unconditioned Space	Buried	Unconditioned Space and Buried Ducts		90.1-2007	90.1-2019*
0	NA	none		NA	NA	NA	NA	NA	none		NA	none
1	none	none		none	none	none	none	none	none		none	none
2	none	R-6		none	none	none	none	none	R-6		none	R-1.9
3	R-3.5	R-6		none	none	none	none	none	R-6		none	R-1.9
4	R-3.5	R-6		none	none	none	none	none	R-6		none	R-1.9
5	R-6	R-12		R-3.5	none	none	none	R-3.5	R-6		none	R-1.9
6	R-6	R-12		R-6	R-3.5	none	none	R-3.5	R-6		none	R-1.9
7	R-8	R-12		R-6	R-6	none	R-3.5	R-3.5	R-6		none	R-1.9
8	R-8	R-12		R-8	R-6	none	R-6	R-6	R-6		none	R-1.9

*ASHRAE 90.1-2019 insulation values apply to both supply and return ducts. 90.1-2007 values apply to supply ducts only.

Section 6 – HVAC (2)

Ductwork and Piping Insulation Updates

6.4.4 – HVAC System Construction and Insulation

Cooling-Only Ducts												
	Exterior			90.1-2007					90.1-2019*		Indirectly Conditioned Sp	
Climate Zone	90.1-2007	90.1-2019*		Ventilated Attic	Unvented Above Insulated Ceiling	Unvented with Roof Insulation	Unconditioned Space	Buried	Unconditioned Space and Buried Ducts		90.1-2007	90.1-2019*
0	NA	none		NA	NA	NA	NA	NA	none		NA	none
1	R-6	R-8		R-6	R-8	R-3.5	R-3.5	R-3.5	R-6		none	R-1.9
2	R-6	R-8		R-6	R-6	R-3.5	R-3.5	R-3.5	R-6		none	R-1.9
3	R-6	R-8		R-6	R-6	R-3.5	R-1.9	none	R-6		none	R-1.9
4	R-3.5	R-8		R-3.5	R-6	R-1.9	R-1.9	none	R-6		none	R-1.9
5,6	R-3.5	R-8		R-1.9	R-3.5	R-1.9	R-1.9	none	R-6		none	R-1.9
7,8	R-1.9	R-1.9		R-1.9	R-1.9	R-1.9	R-1.9	none	R-1.9		none	R-1.9

*ASHRAE 90.1-2019 insulation values apply to both supply and return ducts. 90.1-2007 values apply to supply ducts only.

Section 6 – HVAC (3)

Ductwork and Piping Insulation Updates

6.4.4 – HVAC System Construction and Insulation

Heating & Cooling Ducts												
	Exterior			90.1-2007					90.1-2019*		Indirectly Conditioned Sp	
Climate Zone	90.1-2007	90.1-2019*		Ventilated Attic	Unvented Above Insulated Ceiling	Unvented with Roof Insulation	Unconditioned Space	Buried	Unconditioned Space and Buried Ducts		90.1-2007	90.1-2019*
0	NA	none		NA	NA	NA	NA	NA	none		NA	none
1	R-6	R-8		R-6	R-8	R-3.5	R-3.5	none	R-6		R-3.5	R-1.9
2	R-6	R-8		R-6	R-6	R-3.5	R-3.5	none	R-6		R-3.5	R-1.9
3	R-6	R-8		R-6	R-6	R-3.5	R-3.5	none	R-6		R-3.5	R-1.9
4	R-6	R-8		R-6	R-6	R-3.5	R-3.5	none	R-6		R-3.5	R-1.9
5	R-6	R-12		R-6	R-6	R-1.9	R-3.5	none	R-6		R-3.5	R-1.9
6	R-8	R-12		R-6	R-6	R-1.9	R-3.5	none	R-6		R-3.5	R-1.9
7	R-8	R-12		R-6	R-6	R-1.9	R-3.5	none	R-6		R-3.5	R-1.9
8	R-8	R-12		R-8	R-8	R-1.9	R-6.0	none	R-6		R-6	R-1.9

*ASHRAE 90.1-2019 insulation values apply to both supply and return ducts. 90.1-2007 values apply to supply ducts only.

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Section 6 – HVAC (4)

Ductwork and Piping Insulation Updates

6.4.4 – Piping Insulation

Fluid Operating Temperature Range (°F) and Usage	Insulation Conductivity		Nominal Pipe or Tube Size (in.)									
	Conductivity, Btu·in./(h·ft2·°F)	Mean Rating Temperature, °F	<1		1 to <1-1/2		1-1/2 to <4		4 to <8		≥8	
			Insulation Thickness (in.)									
			2007	2019	2007	2019	2007	2019	2007	2019	2007	2019
>350	0.32 to 0.34	250	2.5	4.5	3.0	5.0	3.0	5.0	4.0	5.0	4.0	5.0
251 to 350	0.29 to 0.32	200	1.5	3.0	2.5	4.0	3.0	4.5	3.0	4.5	3.0	4.5
201 to 250	0.27 to 0.30	150	1.5	2.5	1.5	2.5	2.0	2.5	2.0	3.0	2.0	3.0
141 to 200	**0.25 to 0.29**	**125**	**1.0**	**1.5**	**1.0**	**1.5**	**1.0**	**2.0**	**1.5**	**2.0**	**1.5**	**2.0**
105 to 140	**0.22 to 0.28**	**100**	**0.5**	**1.0**	**0.5**	**1.0**	**1.0**	**1.5**	**1.0**	**1.5**	**1.0**	**1.5**

★ New Requirement

Section 6 – HVAC (5)

Equipment Sizing and Efficiencies

- 6.4.2.1 – Load calculations must follow ~~generally accepted engineering standards~~ ASHRAE / ACCA Standard 183.
- 6.4.2.2 – Pump Head for sizing of pumps must be based on pressure drop through critical circuit throughout piping system at design conditions.
- 6.5.3.1 – Introduction of Fan Efficiency Grades
  - less likely to apply to dwelling units but could apply to central common area systems with combined fan hp of 5 or more.
    - Excludes individual exhaust fans of 1 hp or less
- 6.5.3.6 – Minimum efficiencies for fractional horsepower motors
  - >1/12 hp or <1 hp motors to have:
    - electronically commutated motors, OR
    - A minimum motor efficiency of 70%

Questions?

Office of Energy Efficiency & Renewable Energy