U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

What You Need to Know About the New Energy Standard for Commercial Buildings: ASHRAE Standard 90.1-2022

Building Energy Code Webinar Series

Building Technologies Office

November 16, 2023

BECP WEBINAR SERIES LINEUP

Catch the entire lineup of sessions the third Thursday of each month @ 1p ET.

- 9/21/23: How Building Codes Facilitate Resilient Communities
- 10/19/23: Strategies to Equitably Expand the Energy Codes Workforce
- 11/16/23: What You Need to Know About the New Energy Standard for Commercial Buildings: ASHRAE 90.1-2022
- 1/18/24: Best Practices for Understanding and Improving Compliance: Field Studies, Circuit Riders, and More
- 2/15/24: Addressing Existing Buildings: Building Performance Standards and Implementation Support Tools
- 3/21/24: Energy Code Enforcement Challenges and Opportunities in Rural Communities

....and more to come

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LEARNING OBJECTIVES

1. Summarize the main changes to ASHRAE Standard 90.1-2022 from 90.1-2019
2. Understand the implications of the lighting requirement changes
3. Summarize the new energy credit requirements
4. Identify the new thermal bridging requirements

Building Energy Codes
U.S. DEPARTMENT OF ENERGY

TODAY'S SPEAKERS

Don Brundage, Southern Company - Member of SSPC 90.1, Chair of SSPC 90.1 during the 2022 development cycle

Len Sciarra, Farr Associates - Vice Chair of SSPC 90.1, Chair of the Envelope Subcommittee during the 2022 development cycle

Michael Myer, PNNL - Consultant to SSPC 90.1 Lighting Subcommittee

Richard Lord, Carrier Corporation - Chair of SSPC 90.1, Vice Chair of SSPC 90.1 during the 2022 development cycle

Michael Tillou, PNNL - Chair of the Energy Credits Working Group, Consultant to SSPC 90.1 Envelope and Energy Cost Budget

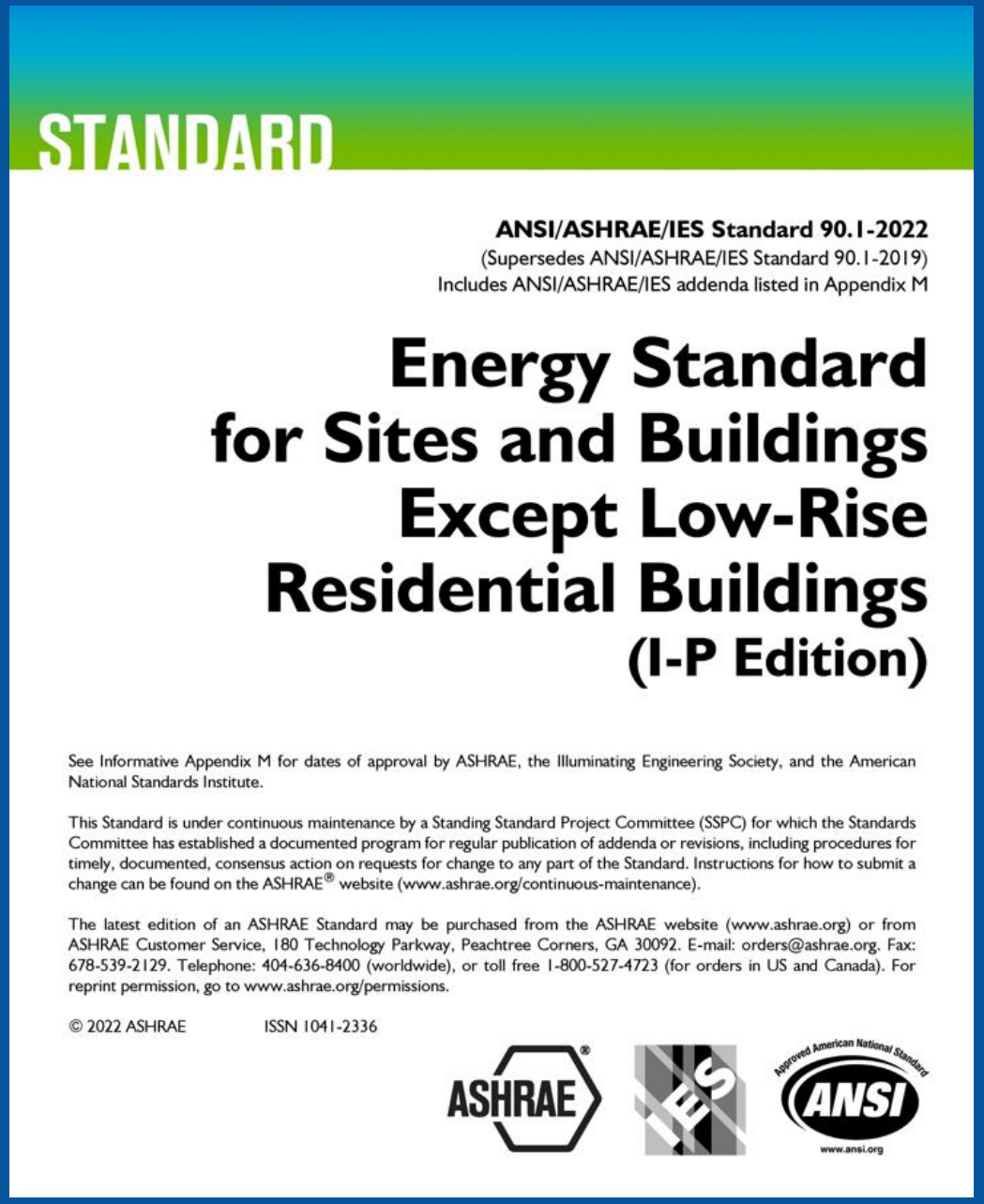
Michael Rosenberg, PNNL - Member of SSPC 90.1 and the Energy Cost Budget Subcommittee

Building Energy Codes
U.S. DEPARTMENT OF ENERGY

What is New in ANSI/ASHRAE/IES 90.1 -2022 BECP Energy Code Webinar Series

Presented by
ASHRAE 90.1 SSPC Committee Members

Thursday, November 16, 2023
1:00-3:00pm ET (12 CT /11 MT /10 PT)


STANDARD

ANSI/ASHRAE/IES Standard 90.1-2022
(Supersedes ANSI/ASHRAE/IES Standard 90.1-2019)
Includes ANSI/ASHRAE/IES addenda listed in Appendix M

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

See Informative Appendix M for dates of approval 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, 180 Technology Parkway, Peachtree Corners, GA 30092. 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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www.ansi.org

Introduction

Don Brundage

Agenda

Agenda Topic	Presenter
Introduction and Overview of ASHRAE 90.1-2022	Don Brundage
Envelope Changes (Section 5)	Len Sciarra
Power, Lighting, & Renewables (Sections 8, 9, & 10)	Michael Myer
Energy Cost Budget Method (Section 12 and Appendix G)	Michael Rosenberg
Mechanical Equipment (Section 6, 7, and 8)	Richard Lord
Total System Power Ratio (Section 6, 7, and 8)	Michael Tillou
Additional Efficiency Requirements (Energy Credits) (Section 11)	Michael Tillou
Questions and Answers	All

Don Brundage

Don Brundage

Currently retired, Former Codes and Standards Principal, Southern Company Services, Former Chair of SSPC 90.1.

Don Brundage has 42 years of experience in the electric and gas utility industries, most of it involved with various aspects of energy efficiency regulations, including equipment energy efficiency standards and building codes.

He was employed by Southern Company Services, a subsidiary of Southern Company, which provides 9 million customers with energy through its electric and gas utilities and various energy and telecommunications subsidiaries. His responsibilities included responsibility for energy efficiency regulatory issues at the national level for electric and gas equipment used by Southern Company's customers.

In addition to Standard 90.1, he is also active on TC 2.5 Global Climate Change and is current chair of the Global Climate Change Position Document Committee. He has previously served as a member of Technology Council, Chair of Standards Committee, Chair of Technical Activities Committee, Chair of TC 2.5 Global Climate change.

His is a Professional Engineer in the state of Georgia, and a Certified Energy Manager.

Len Sciarra

Leonard Sciarra, AIA, LEED Fellow, ASHRAE

Principal, Sustainability and Technical Director

Len joined Farr Associates in 2021. He is a recognized expert in integrating sustainable design principals into architectural practice. Len is an advocate for environmental thinking and energy efficiency as a necessary part of good design.

A strategic problem-solver, Len brings over 20 years' experience to his sustainability projects. His career includes many examples of green design leadership and advocacy, including as chair of the AIA Committee on the Environment, and as key player in the passage of benchmarking ordinances in Chicago and Evanston.

FARR ASSOCIATES

ASHRAE

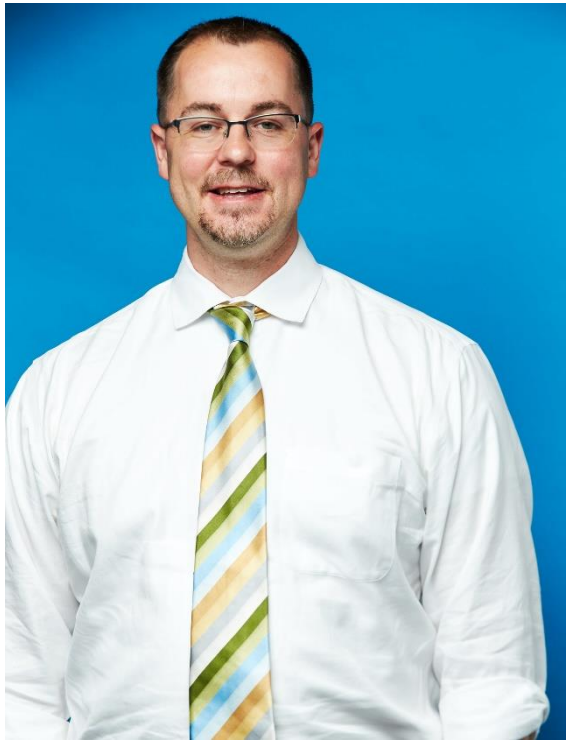
Michael Myer

Michael Myer

Senior Research Analyst

Michael joined Pacific Northwest National Laboratory (PNNL) in 2007. His work is a combination of regulatory programs and commercial building market transformation. Within regulatory programs, Michael has supported multiple appliance standards for different commercial equipment and supports multiple energy codes. Within the commercial building integration, Michael supports field evaluations of novel technologies and market transformation projects.

He is a father to two teenagers, a husband, and a cat-wrangler. When not working, Michael is often working against the constant entropy of home ownership.



Pacific Northwest NATIONAL LABORATORY

ASHRAE

Michael Rosenberg

Michael Rosenberg

Chief Scientist

Michael Rosenberg is a Chief Scientist at Pacific Northwest National Laboratory. He is the Program Manager for PNNL's Building Energy Codes Program, leading the team that provides technical analysis and support for development and implementation of energy codes and standards.

Mr. Rosenberg has worked for over 25 years upgrading building energy codes, designing high performance buildings, analyzing complex building systems, providing training to code officials and design professionals, and developing and managing beyond-code energy programs.

He has combined his expertise in code development and building simulation to become a national leader in the effort to transition energy codes to a performance basis. He is a member of the ASHRAE Standard 90.1 Committee, the ASHRAE Standard 90.1 Energy Cost Budget Subcommittee, the ASHRAE Advanced Energy Standards Working Group, the Canadian Standards Association Technical Committee on Building Energy Systems, and a former member of the USGBC's LEED Energy and Atmosphere Technical Advisory Group.

Richard Lord

Richard Lord

Sr. Carrier Fellow, ASHRAE Fellow, Chair of ASHRAE 90.1

Richard Lord has 50 years of experience in the design and application of commercial air conditioning equipment and controls 50with expertise in systems, fluids, refrigerants, heat transfer, heat exchanger design, software, controls, diagnostics, commercial efficiency and building standards and codes.

He is employed by Carrier Corporation and located in Monteagle, Tennessee, and is member of the Carrier Research and Development Electromechanical Organization working on refrigerants and commercial equipment advanced technology and systems innovation and is also involved industry standard, regulations and research.

He is the chair of ASHRAE 90.1, member of ASHRAE 189.1, ASHRAE 196, ASHRAE 205, ASHRAE 207, IECC Mechanical, chair of CSA 401, CSA 424, CSA Scooper, California CEA, UL60335-2-40, AHRI 340/360, AHRI 550/590, and several other industry organizations and standards groups.

Michael Tillou

Michael Tillou

Senior Research Scientist

Michael Tillou joined PNNL in 2020 as a Senior Research Scientist. He supports PNNL's commercial energy code development team providing technical analysis and support for cost-effective upgrades to national model energy codes and standards including ASHRAE Standard 90.1 and the International Energy Conservation Code.

Michael has worked for over 25 years as an energy analyst supporting the design and operation of high-performance buildings, analyzing complex building systems, and providing training to code officials and design professionals. He has combined his expertise in code development and building simulation to become a leader in the effort to transition to performance-based energy codes.

Pacific Northwest NATIONAL LABORATORY

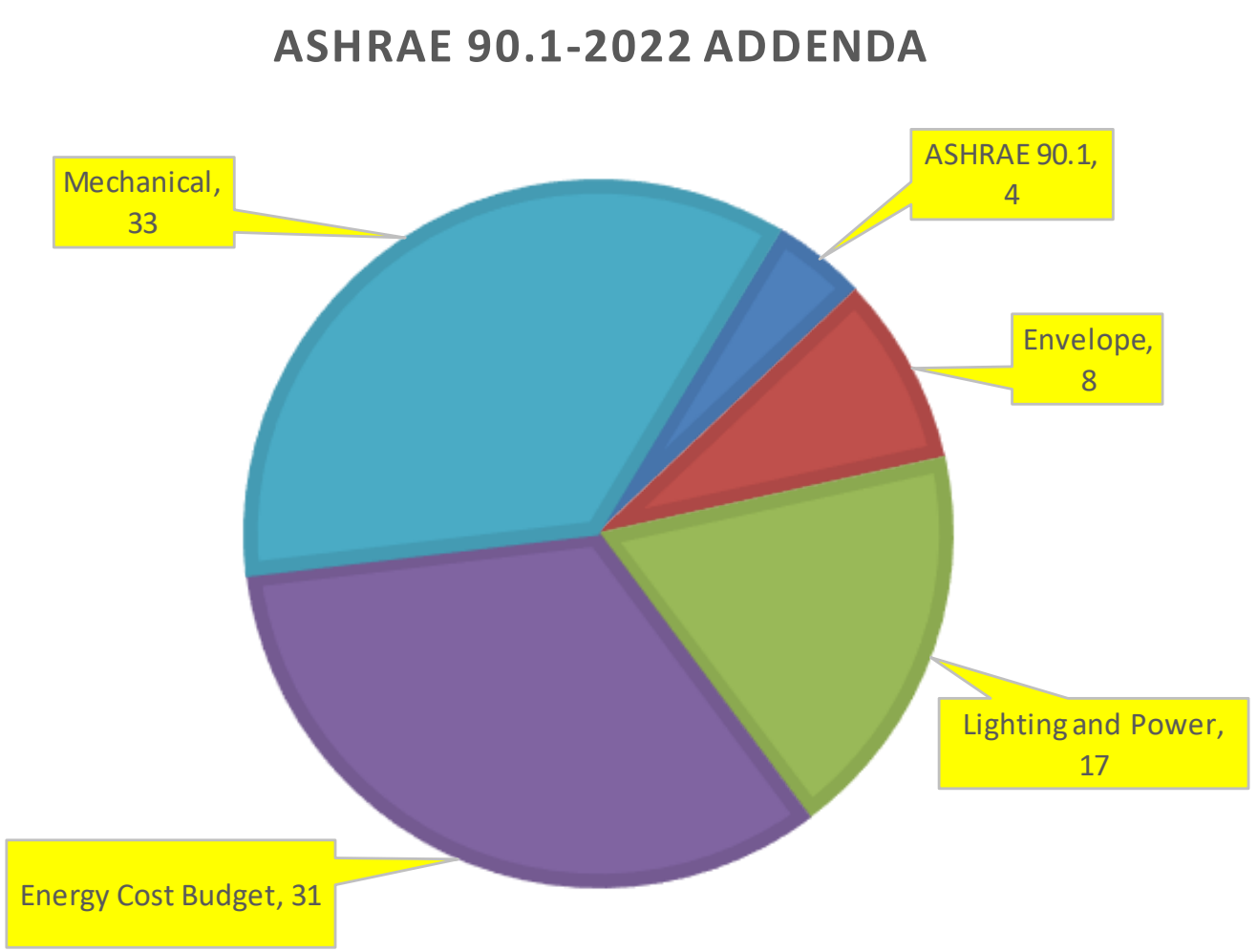
ASHRAE

Overall Summary

Don Brundage

Overview of ASHRAE 90.1-2022 Changes

- Number of pages 2019 = 428 , 2022 = 462
- Number of addenda = 95
  - 88 ANSI Approved Normative Addenda
  - 7 Informative
- ASHRAE 90.1-2022 added new sections and appendices
  - Added Section 11 – Additional Efficiency Requirements (Credits)
  - Informative Appendix I – Using other Metrics in Conjunction with Appendix G Performance Rating Method when Approved by the Rating Authority (Carbon Emissions)
  - Normative Appendix J – Set of Performance Curves (chillers) (used for baseline models)
  - Normative Appendix L – Mechanical System Performance Rating Method (TSPR)



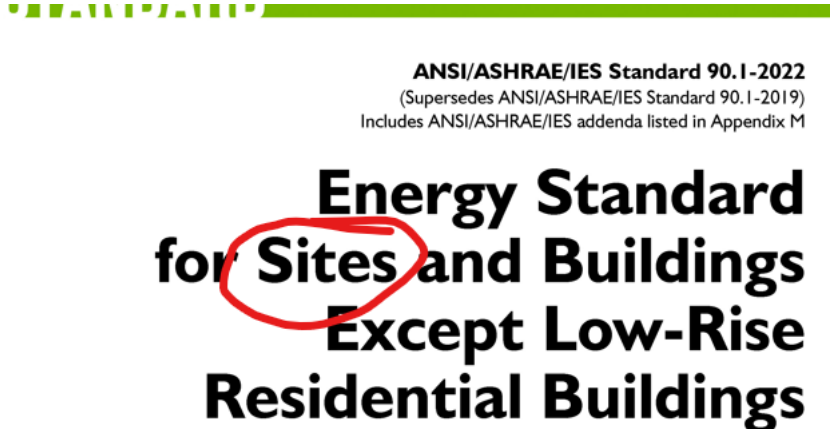
ASHRAE 90.1 Sections

ASHRAE 90.1 - 2019			ASHRAE 90.1 -2022	
Section	Title		Section	Title
	Foreword			Foreword
2	Scope		2	Scope
3	Definitions, Abbreviations, and Acronyms		3	Definitions, Abbreviations, and Acronyms
4	Administration and Enforcement		4	Administration and Enforcement
5	Building Envelope		5	Building Envelope
6	Heating, Ventilation, and Air Conditioning		6	Heating, Ventilation, and Air Conditioning
7	Service Water Heating		7	Service Water Heating
8	Power		8	Power
9	Lighting		9	Lighting
10	Other Equipment		10	Other Equipment
		new	11	Additional Efficiency Requirements
11	Energy Cost Budget Method		12	Energy Cost Budget Method
12	Normative References		13	Normative References

ASHRAE 90.1 Appendices and Annexes

ASHRAE 90.1 - 2019			ASHRAE 90.1 -2022	
Appendix	Title	changed	Appendix	Title
Appendix A	Rated R-Values of Insulation and Assembly U-Factors, C-Factors and F-Factor Determination	updates	Appendix A	Rated R-Values of Insulation and Assembly U-Factors, C-Factors and F-Factor Determination
Appendix B	(Retained for Future Use)	NA	Appendix B	(Retained for Future Use)
Appendix C	Methodology for Building Envelope Trade-Off Option in Section 5.6	updates	Appendix C	Methodology for Building Envelope Trade-Off Option in Section 5.6
Appendix D	(Retained for Future Use)	NA	Appendix D	(Retained for Future Use)
Appendix E	Informative References	Updates	Appendix E	Informative References
Appendix F	U.S. Department of Energy Minimum Energy Efficiency Requirements	Updates	Appendix F	U.S. Department of Energy Minimum Energy Efficiency Requirements
Appendix G	Performance Rating Method	Updates	Appendix G	Performance Rating Method
Appendix H	Additional Guidance for Verification, Testing and Commissioning	New in 2019	Appendix H	Additional Guidance for Verification, Testing and Commissioning
		New	Appendix I	Using Other Metrics in Conjunction with Appendix G Performance Rating Method when Approved by the Rating Authority
		New	Appendix J	Sets of Performance Curves
		New	Appendix K	Informative Figures – Thermal Bridges
		New	Appendix L	Mechanical System Performance Rating Method
Appendix I	Addenda Description Information	updates	Appendix M	Addenda Description
Annex 1	Reference Standard Reproduction Annex – ASHRAE Standard 169	No Change	Annex 1	Reference Standard Reproduction Annex – ASHRAE Standard 169

ASHRAE 90.1 New Title, Purpose, and Scope



- Including **sites** accounts for the whole picture of building energy use
- Can now capture energy use (parking lot lighting) and production (renewables) happening exterior to the building

- Approved November 2021

Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

Purpose: To establish the minimum *energy efficiency* requirements of *buildings* other than *low-rise residential buildings*, and *sites* for

a. design, *construction*, and a plan for operation and maintenance; and

b. utilization of on-site, renewable *energy* resources.

Scope:

2.1 This standard provides

a. minimum *energy*-efficient requirements for the design and *construction*, and a plan for operation and maintenance of

1. new *buildings* and their *systems*,
2. new portions of *buildings* and their *systems*,
3. new *systems* and *equipment* specifically identified in this standard that are part of a *site*,
4. new *systems* and *equipment* in *existing buildings*, and
5. new *equipment* or *building systems* specifically identified in this standard that are part of *process applications* and

b. criteria for determining compliance with these requirements.

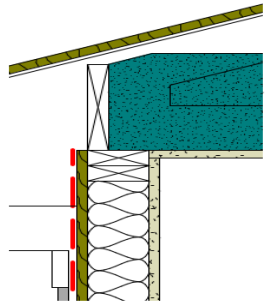
Envelope Changes

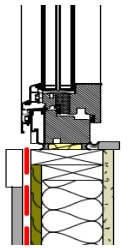
Len Sciarra

Section 5 – Building Envelope

Updated Requirements

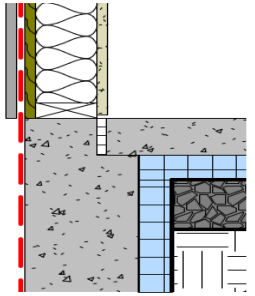
- Air Leakage
- Roof replacements
- Envelope commissioning
- Insulated metal panels (IMP
- Compliance calculations to steel-framed walls



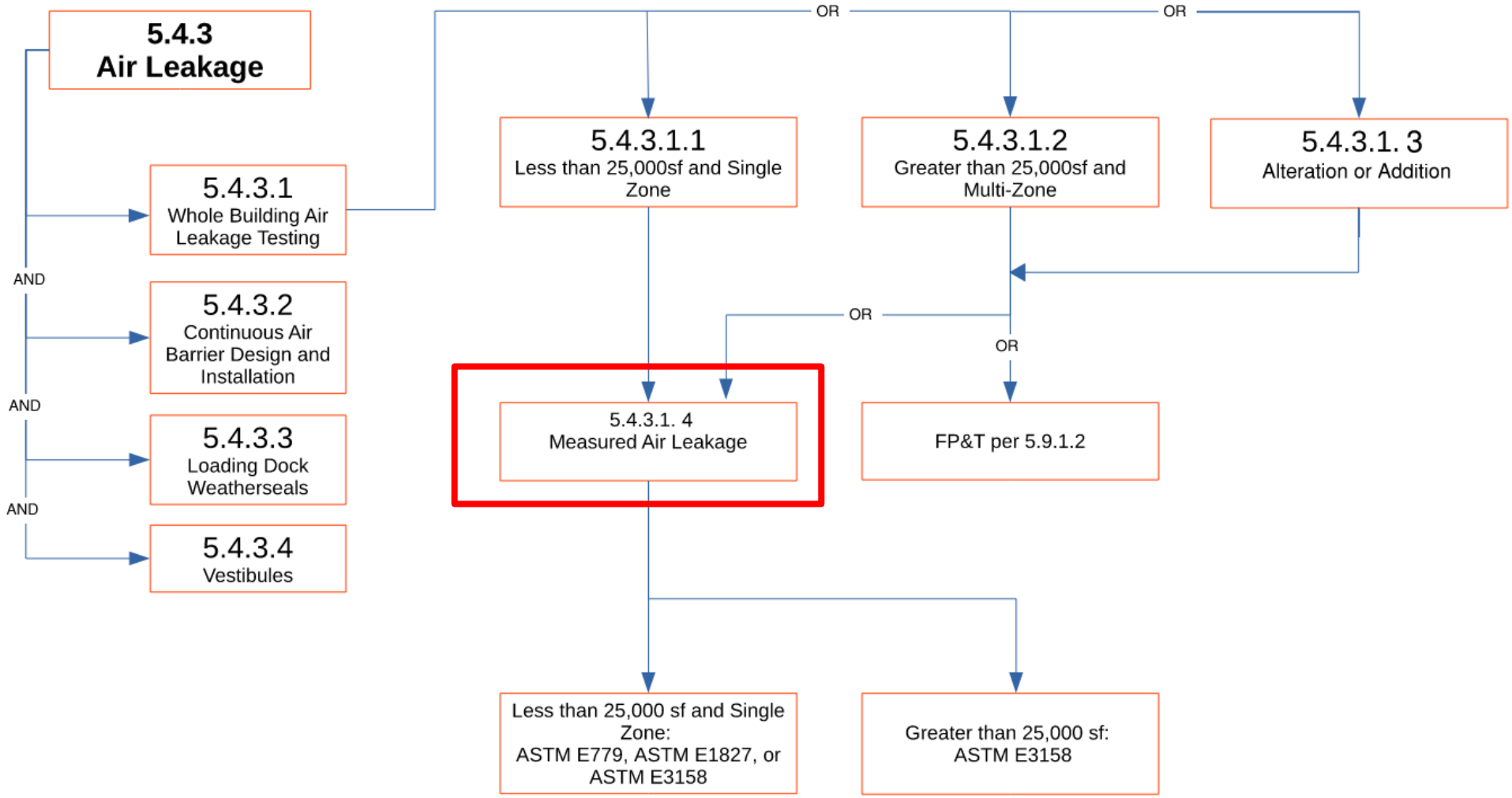


New Concepts

- Wall solar reflectance
- Thermal bridging
- Envelope backstop



Section 5.4.3 – Air Leakage



Envelope Updates

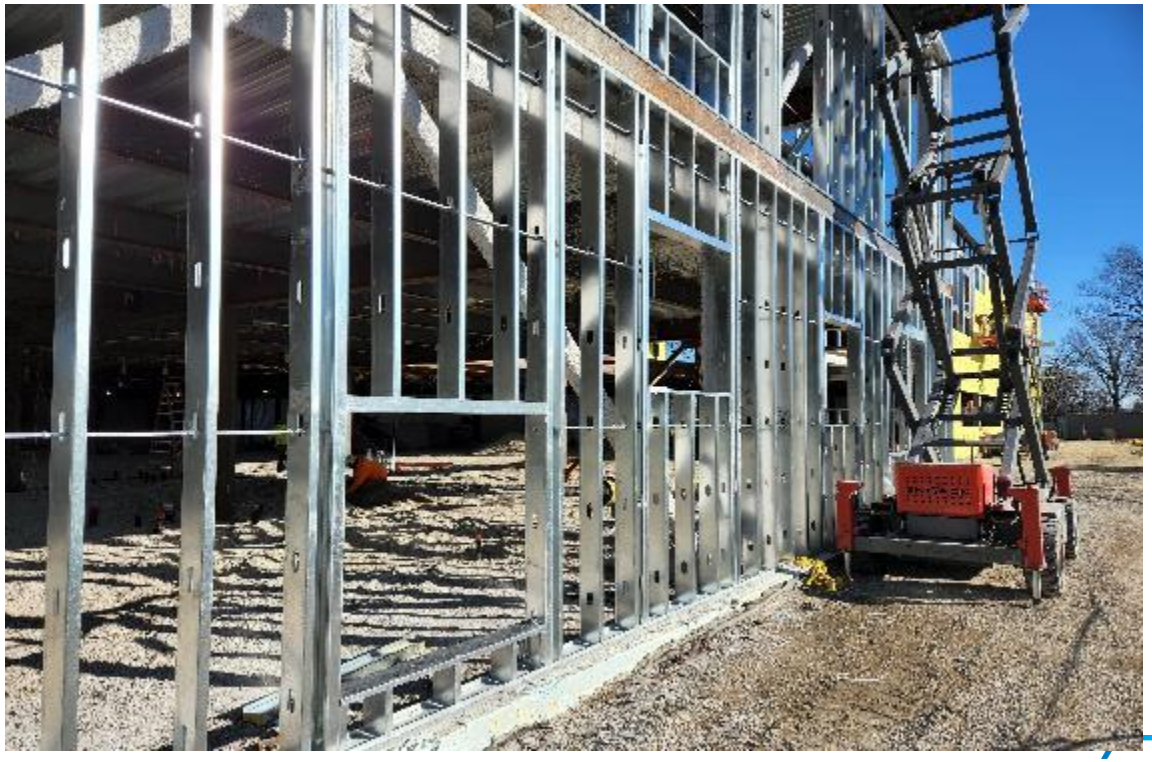
ROOF REPLACEMENT

ENVELOPE COMMISSIONING

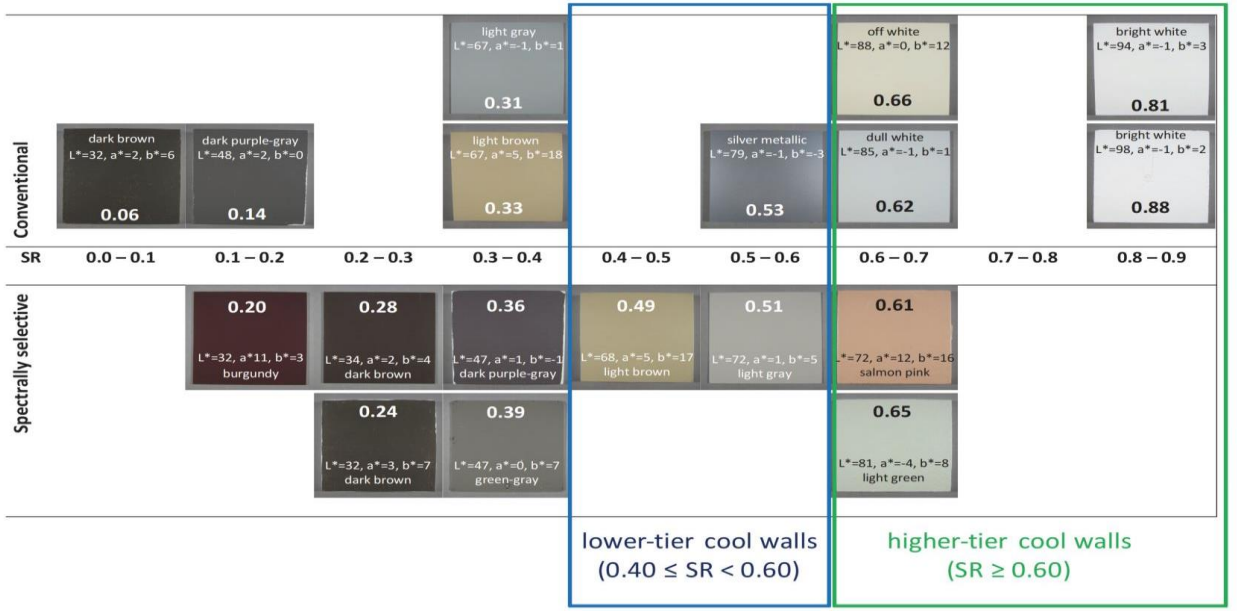
Envelope Updates

INSULATED METAL PANELS

METAL FRAMED WALLS
AKA
COLD FORMED METAL FRAMING
AKA
METAL STUDS



Envelope Updates – Wall Solar Reflectance



Envelope Updates – Thermal Bridging

Envelope Updates – Thermal Bridging

Exceptions to 5.5.5:

1) Buildings located in Climate Zones 0 through 3.
2) Semiheated spaces in buildings located in Climate Zones 0 through 6.
3) Clear-field thermal bridges.
4) Thermal bridges in uninsulated assemblies.
5) Linear and point thermal bridges that have a material thermal conductivity less than 3.0 Btu·in/h·ft2·°F0.433 W/(m·K).
6) Alterations to existing buildings other than additions.
7) Roofs that project over exterior walls.

Envelope Updates – Thermal Bridging

1

- ROOF TO WALL
- INTERMEDIATE FLOOR TO WALL
  - BALCONIES
- CLADDING SUPPORT
- WINDOW
- OTHER LARGE PENETRATIONS

2 INCREASE IN R-VALUE TRADE OFF

3 DEFAULT psi & chi FACTORS FOR MODELING TRADE OFF

Envelope Updates – Thermal Bridging

Power, Lighting, and Renewables

Michael Myer

Power

Michael Myer

Section 8 – Power

Updated Requirements

- Energy Monitoring (8.4.3.1) | adds refrigeration systems
- Dry-Type Distribution Transformers (8.4.4) | Updates / clarifications to match regulations adopted by U.S. DOE (10 CFR 461.192)
- Minor clarifications and updates

Lighting

Michael Myer

Section 9 – Lighting

Updated Requirements

- Editorial reorganization → sub sections match other Sections
- Clarifications / streamline of lighting controls requirements
- Simplified Building Method (9.3.2)
- Exterior Lighting (9.4.2)
- Interior Lighting Power Density (9.5.1 and 9.5.2)

New Concepts

- Horticultural lighting requirements (9.4.4)
- Video conference allowance (9.5.2.2)

Simplified Building Method

Interior Space Type and LPA	Controls
Interior office LPD: 0.56 W/ft² (6.0 W/m²)	
All *spaces* in office *buildings*	All lighting shall be *automatically* controlled to turn off when individual *spaces* are either unoccupied or scheduled to be unoccupied. (**Exception:** Lighting load not exceeding 0.02 W/ft² multiplied by the gross lighted area of the *space* shall be permitted to operate at all times.)
Office *spaces* ≤150 ft², classrooms, conference rooms, meeting rooms, training rooms, storage rooms, and break rooms	These *spaces* shall be controlled by *manual-ON occupant sensors*.
Office *spaces* >150 ft² and restrooms	These *spaces* shall be controlled by *occupant sensors*.
Stairwells and corridors in office *buildings*	These *spaces* shall be controlled by *occupant sensors* that reduce the lighting power by a minimum of 50% when no activity is detected for not longer than 15 minutes and be controlled to turn off when the *building* is either unoccupied or scheduled to be unoccupied.
All other *spaces* in office *buildings*	Each *space* shall have a *manual control* device that allows the occupant to reduce lighting power by a minimum of 50% and to turn the lighting off.
Parking garages *LPD*: 0.14 W/ft² for the interior parking floors. Uncovered floors of a garage shall comply with the requirementsof Table 9.3.2 for parking lots.	All lighting shall be controlled by *occupant sensors*. Controls shall reduce the power by a minimum of 50% when no activity is detected for not longer than 15 minutes. No device shall *control* more than 3600 ft² (334 m²).

9.3.2 Simplified Building Method

- Adds an option for lighting – other sections have simplified methods
- Lower lighting power density than the space-by-space or building area method
- Limited controls requirements
- Only applicable to 3 building types: office, education, and retail
- Only applicable to buildings under 25,000 ft²
- Maybe a choice for design-build community

Interior Lighting Power Density

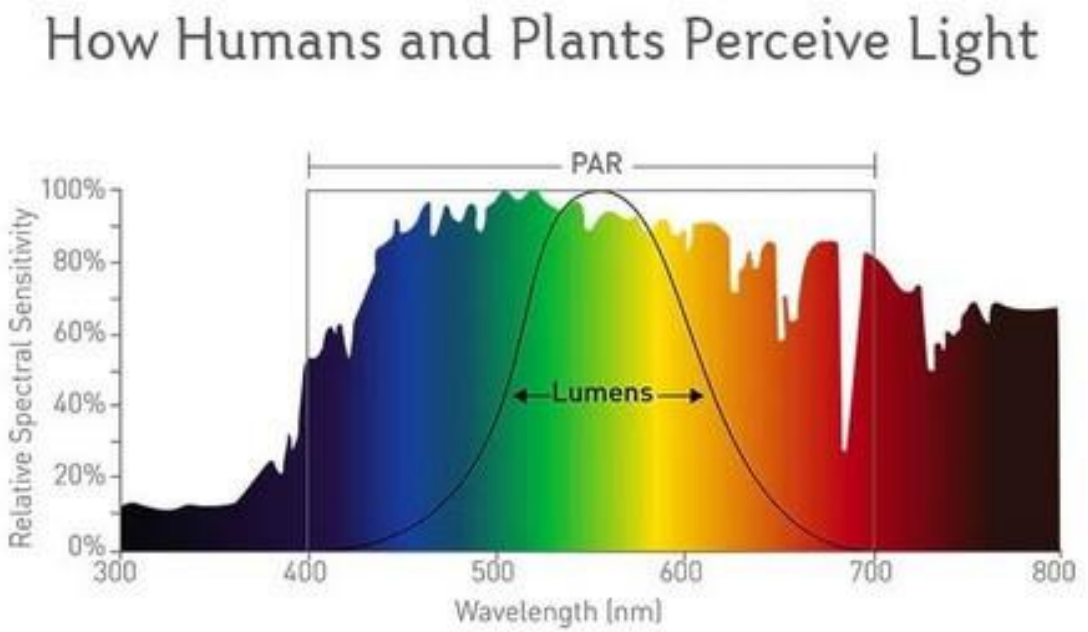
	Zone 0	Zone 1	Zone 2	Zone 3	Zone 4	Section 9.4.1.4 Required Controls
Base Site Allowance (Base allowance may be used in tradable or non-tradable surfaces.)						
	____	160 W	280 W	400 W	560 W	
Tradable Surfaces (*LPD* for uncovered parking areas, *building* grounds, *building entrances*, exits and loading docks, canopies and overhangs, and outdoor sales areas may be traded.)						
Uncovered Parking Areas						
Parking areas and drives	____	0.015 W/ft²	0.026W/ft²	0.037 W/ft²	0.052 W/ft²	(b) and either (d) or (e)
Parking areas and drives with *luminaires* >78W and mounting height <24 ft	____	0.015 W/ft²	0.026 W/ft²	0.037 W/ft²	0.052 W/ft²	(b) and (e)
Grounds						
Walkways/ramps	____	0.5 W/linear ft	0.5 W/linear ft	0.55W/linear ft	0.60 W/linear ft	(b) and either (d) or (e)
Plaza areas	____	0.028 W/ft²	0.049 W/ft²	0.070 W/ft²	0.098 W/ft²	(b) and either (d) or (e)
Roof terraces and special features	____	0.04 W/ft²	0.07 W/ft²	0.10 W/ft²	0.140 W/ft²	(b) and either (d) or (e)
Dining areas	____	0.156 W/ft²	0.273 W/ft²	0.390 W/ft²	0.546 W/ft²	(b) and either (d) or (e)
Pedestrian tunnels	____	0.063 W/ft²	0.110 W/ft²	0.157 W/ft²	0.220 W/ft²	(d) or (e)
Landscaping		0.014 W/ft²	0.025 W/ft²	0.036 W/ft²	0.050 W/ft²	(b) and (c)

9.4.2 Exterior Lighting

- Adds column of controls requirements, not new requirements, just clarifies what controls are required
- Lowered power values – 1st time since 2016
- 30% reduction from 2016 values

Horticultural Lighting

9.4.4.1 *Luminaires* in *greenhouse buildings* with at least 40 *kW* of connected load for *horticultural lighting* shall have a *photosynthetic photon efficacy* (*PPE*) of at least 1.7 µmol/J for integrated, non-serviceable *luminaires*, or a *PPE* of at least 1.7 µmol/J for *lamps* in *luminaires* with removable or serviceable *lamps*



Video conferencing

9.5.2.2 Additional Lighting Power

Creates a new allowance category for video conferencing spaces

Table 9.5.2.2 Additional Lighting Power

Section	Description	Additional Lighting Power	Required Controls
9.5.2.2(a)	Decorative	0.70 W/ft^2	Section 9.4.1.1(j)
9.5.2.2(b)	Retail sales	750 W + (Retail Area 1 × 0.40 W/ft^2) + (Retail Area 2 × 0.40 W/ft^2) + (Retail Area 3 × 0.70 W/ft^2) + (Retail Area 4 × 1.00 W/ft^2)	Section 9.4.1.1(j)
9.5.2.2(c)	Video conferencing	0.50 W/ft^2	See Tables 9.5.2.1-1 and 9.5.2.1-2 space types for required controls.

Notes:

Retail Area 1 = the *floor* area for all products not listed in Retail Areas 2, 3, or 4

Retail Area 2 = the *floor* area used for the sale of vehicles, sporting goods, and small electronics

Retail Area 3 = the *floor* area used for the sale of furniture, clothing, cosmetics, and artwork

Retail Area 4 = the *floor* area used for the sale of jewelry, crystal, and china

Renewable Energy (10.5 Prescriptive Compliance Path)

Michael Myer

Section 10 – Other Equipment – Renewable Energy Resources

New: Prescriptive Compliance Path

10.5.1 Renewable Energy Resources. *Buildings* shall be served by *renewable energy resources* complying with Section 10.5.1.1.

10.5.1.1 On-Site Renewable Energy. The *building site* shall have *equipment* for *on-site renewable energy* with a rated capacity of not less than 0.50 W/ft^2 or 1.7 Btu/ft^2 multiplied by the sum of the *gross conditioned floor area* for all *floors* up to the three largest *floors*.

Exceptions to 10.5.1.1:

1. Any *building* located where an unshaded flat plate collector oriented toward the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 1.1 kBtu/ft^2·day.
2. Any *building* where more than 80% of the *roof* area is covered by any combination of *equipment* other than for *on-site renewable energy systems*, planters, vegetated *space*, *skylights*, or occupied *roof* deck.
3. Any *building* where more than 50% of *roof* area is shaded from direct-beam sunlight by natural objects or by *structures* that are not part of the *building* for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
4. New *construction* or *additions* in which the sum of the *gross conditioned floor area* of the three largest *floors* of the new construction or *addition* is less than 10,000 ft2.
5. *Alterations*

Other Equipment – Renewable Energy Resources

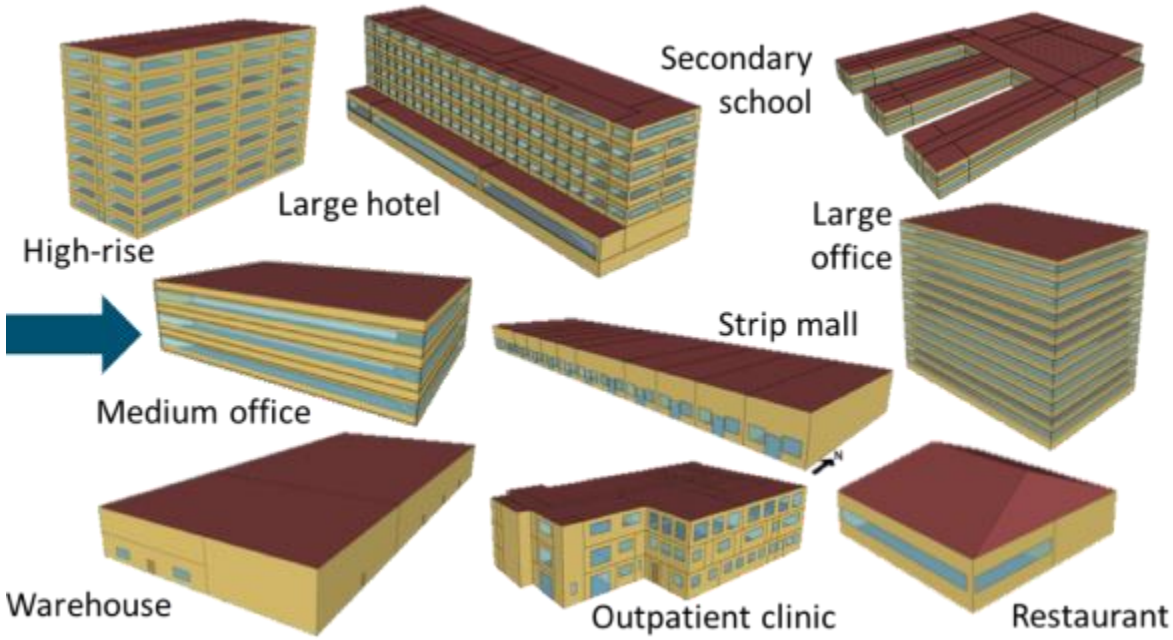
Steps:

1. Sum *gross conditioned floor area* for all *floors* up to the three largest *floors*

Example(s):

- Warehouse: (1) floor = 52,000 ft^2 / floor
- Secondary School (2) floors = 26,000 ft^2 / floor
- Outpatient: (3) floors x 14,000 ft^2 / floor
- High-rise: (10 floors) x 14,000 ft^2 / floor

Each example above has 52,000 ft^2 total GCFA that gets used to calculate the required on-site renewable energy



2. Calculate required renewable capacity on the *building site*:

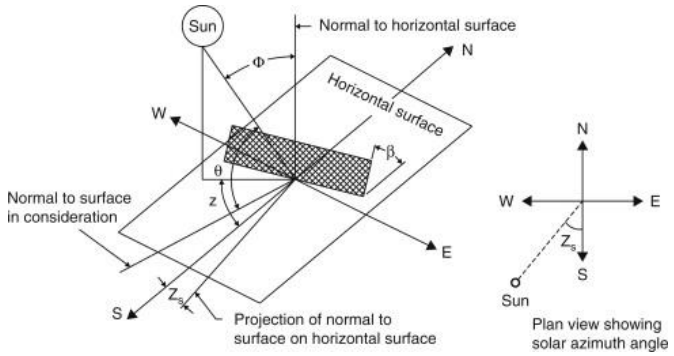
52,000 ft2 x 0.50 W/ft2 = 26,000 W (26 kW)

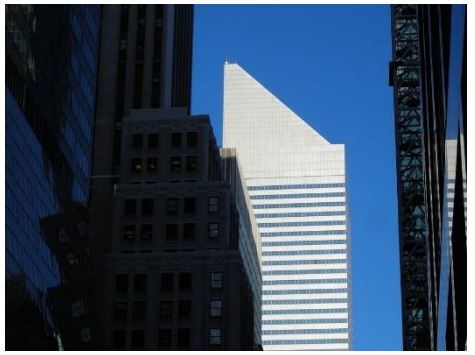
Renewable energy could be on roof, in parking lot, in field, etc. – just needs to be located *on-site*

Other Equipment – Renewable Energy Resources

Exceptions to 10.5.1.1:

1. Any *building* located where an unshaded flat plate collector oriented toward the equator and tilted at an angle from horizontal equal to the latitude receives an annual daily average incident solar radiation less than 1.1 kBtu/ft^2·day.
2. Any *building* where more than 80% of the *roof* area is covered by any combination of *equipment* other than for *on-site renewable energy systems*, planters, vegetated *space*, *skylights*, or occupied *roof* deck.
3. Any *building* where more than 50% of *roof* area is shaded from direct-beam sunlight by natural objects or by *structures* that are not part of the *building* for more than 2500 annual hours between 8:00 a.m. and 4:00 p.m.
4. New *construction* or *additions* in which the sum of the *gross conditioned floor area* of the three largest *floors* of the new construction or *addition* is less than 10,000 ft2.
5. *Alterations*





Mechanical Systems

Richard Lord

Mechanical Systems Overview

- Mechanical Systems are covered by the following Sections and Appendices)
  - **Section 6 – Heating Ventilating, and Air Conditioning (Primary focus of MSC)**
  - **Section 7 – Service Water Heating (Primary Focus of MSC)**
  - Section 8 – Power (Primary focus of L&P Subcommittee)
  - **Section 10 – Other Equipment (Primary focus of MSC)**
  - Section 11 – Additional Efficiency Requirements (Credits - **New** and overall focus of SSPC)
  - Section 12 – Energy Cost Budget Method (Primary focus of ECB)
  - Appendix F – US Department of Energy Minimum Energy Efficiency Requirements, Test Procedures and Definitions
  - Appendix G – Performance Rating Method (Primary focus of ECB)
  - Appendix H – Additional Guidance for Verification, Testing and Commissioning (new in 2019)
  - Appendix J – Sets of Performance Curves (new, Primary focus of ECB) **(new)**
  - **Appendix L – Mechanical System Performance Rating Method (new, Primary focus of MSC, but considerable help from ECB)**
- In the 2022 Standard there were 33 addenda which impacted mandatory, and prescriptive requirements, but also additional new procedures and requirements that were added by overall committee addenda;
  - Total System Performance Ratio (TSPR) for mechanical systems level optional performance
  - Mandatory Energy Credits
  - Performance Curve for Mechanical Systems

  } Will cover in separate presentations
- In addition, there are several equipment efficiency addenda implemented in 2019 standard that went into effect on 1/1/2023

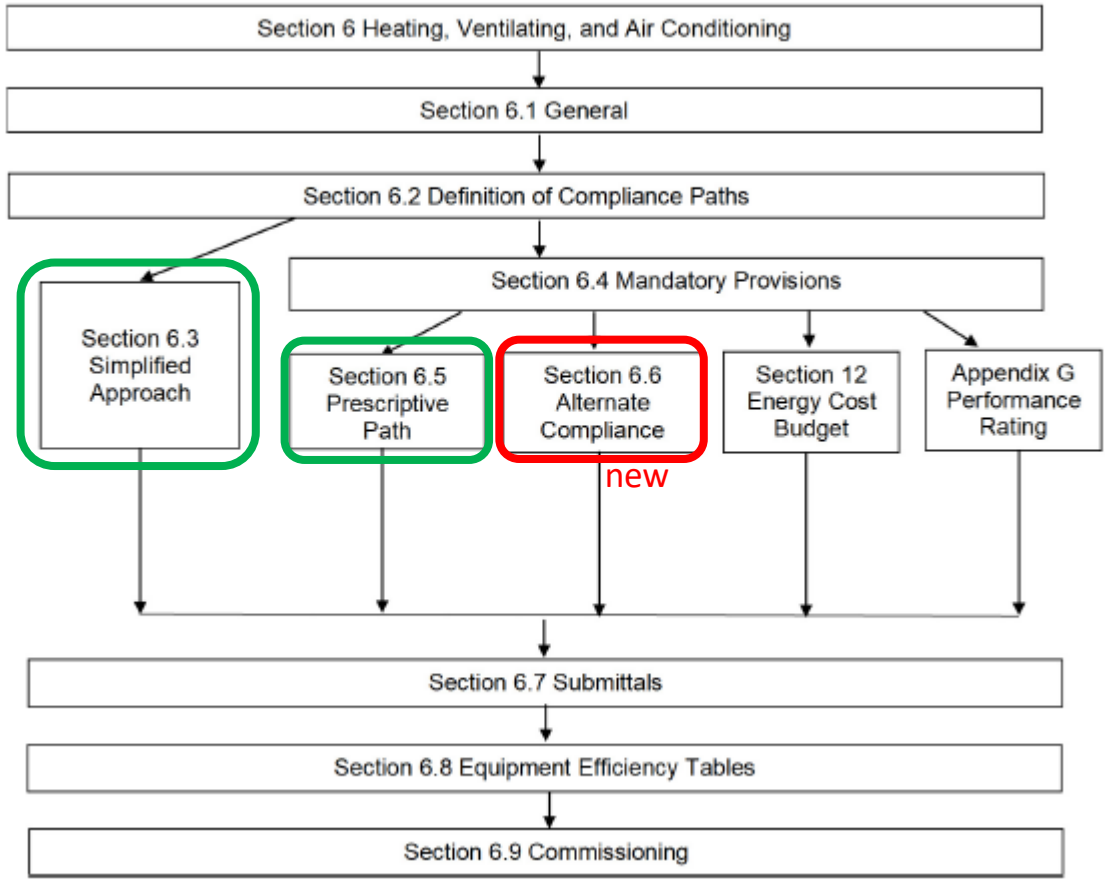
Mechanical System Overview

Mechanical Equipment and Systems efficiency requirements are implemented in several ways;

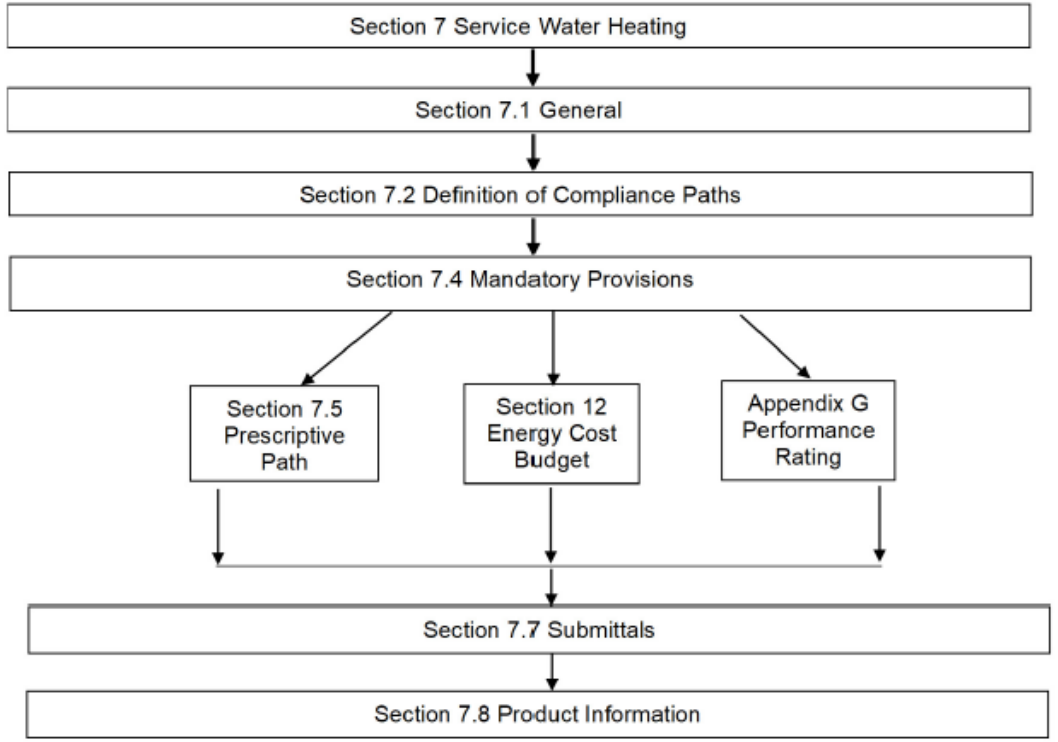
- **Mandatory Requirements**
  - These requirements must be complied with and can not be traded off
  - This includes all the efficiency tables for equipment and components
  - Unique to HVAC&R some equipment is under direct DOE control and these requirements are included in Informative Appendix F. This is limited to less 65,000 Btu/h equipment
  - Also unique to HVAC&R there are some products that are defined by ASHRAE 90.1 but are regulated by DOE and preempt any local state or city requirement. There are a significant number of products that are impacted by this as of 1/1/2023 and more in 1/1/2025
- **Prescriptive Requirements**
  - These are requirements that have options for compliance
  - They can be traded off using the performance options
- **Alternate Compliance (New approach added with TSPR)**
  - This is a relative new path where alternate compliance approach can be used in lieu of the prescriptive requirements
  - In 2019 a new performance path was added for computer rooms
  - In the 2022 standard the Total System Performance Ratio (TSPR) has been added
- **System Level Compliance**
  - This is the full building compliance path where modeling is done per Section 12 or appendix G

Mechanical Compliance Paths

Section 6 – HVAC&R



Section 7 – Service Water Heating



2022 Mechanical Change Overview

- We will not have time to get into the details of all the changes, but we will provide an overview of critical changes. You can also find additional information in **Appendix M of the ASHRAE 90.1-2022** standard

- Detailed training is now being developed and will be available in formal training sessions thru ASHRAE and industry experts

- For today we will give an overview in the following areas for changes to Section 6, 7, and 10 and mechanical systems

  - **Efficiency Tables** (significant changes)

  - **Mandatory Requirements** (except for the new credits which will be covered separately)

  - **Prescriptive Requirements**

  - Alternate Compliance (will be covered in **final presentation on TSPR**)

Efficiency Tables

- There has been considerable activity over the past few years by DOE for federally covered products as well ASHRAE and AHRI for other products which impact the efficiency tables 6.8.1-1 thru 6.8.1-21 and tables F-1 thru F-6

    1. Update to table F-1, F-2 and table 6.8.1-1 and 6.8.1-2 for SEER2 and HSPF2. **(In appendix F all the DOE controlled efficiency requirements are included for easy reference)**

    2. As of 1/1/2018 DOE changed the metric for air cooled commercial rooftops <760,000 Btu/h from **EER to IEER** and as of 1/1/2023 the levels are increasing in table 6.8.1-1 and 6.8.1-2

    3. DOE and AHRI completed an **ASRAC negotiated rule on VRF** and implemented a new test procedure which results in changes to the test procedure and some of the efficiency levels

    4. Updates to **Heat Pump Chiller Heating Efficiency Require**ments listed in table 6.8.1-16

    5. DOE updated the efficiency requirements for dry transformers in 2016 and the updated levels are documented in table 8.4.4

    6. DOE and AHRI completed an **ASRAC negotiated rule for DOAS** units to change the metric from ISMRE to ISMRE2.

Not covered by ASHRAE 90.1, there is another huge change coming for HVAC product **refrigerants** that under the approved AIM Act will go into effect to limit refrigerant **GWP to <750** for chillers and refrigeration as of 1/1/2025, Unitary as of 1/1/2025, and VRF as of 1/1/2026. Some state have implemented earlier regulations for refrigeration and chillers.
For further details see AHRI website for recorded webinars

Residential and Light Commercial <65,000 Btu/h

- **Single Phase Equipment <65,000 Btu/h**
  - As a result of a DOE ASRAC negotiated rule the efficiency metric for <65,000 Btu/h single phase equipment will change from **SEER to SEER2 for cooling and HSPF to HSPF2 for heating**.
  - As part of this change the minimum efficiency levels will increase while still maintaining the 3 residential regional requirements.
  - This change went into effect on 1/1/2023
  - The details for the new metric and test procedure is documented in the AHRI 210/240-2023 standard vs the AHRI 210/240-2017 and by DOE in the M1 procedure vs the M procedure
  - For cooling the major change was an increase in rating static from the old 0.10 to 0.20 in of water for SEER and to **0.50 in water** for SEER2 for conventional ducted products.
  - For the HSPF2 change the static also changes as well as the **load-line** which is based on DOE region IV for the US and region V for Canada which creates different levels for Canada
  - Canada is defining their requirements in amendment 17, 18, and 19 but all the final amendments have not yet been published even though the intended effective date is 1/1/2023
- **Three-phase Equipment <65,000 Btu/h**
  - ASHRAE 90.1 in the 2019 standard also changed the requirements for 3 phase <65,000 Btu/h to align with the residential single-phase equipment for packaged equipment with one common national level with the same effective date of 1/1/2023
  - DOE approved the change in Dec 2022, but with a delayed effective date of 12/11/2023 for the test procedure and 1/1/2025 for the efficiency levels, but ASHRAE 90.1 implanted for **new construction as of 1/1/2023 for states that adopt ASHRAE 90.1**
  - Values are listed 6.8.1-1 and 6.8.1-2 in both the 2019 and 2022 standard.
  - Note there is only one national level for three-phase commercial equipment.

SEER to SEER2 and HSPF to HSPF2 Conversions

The following table list the conversion factor for SEER to SEER2 and HSPF to HSPF2, but actual ratings may change more.

Product Classification		Multiplier			
		SEER2	HSPF2		EER2
			Region IV	Region V*	
AC/Pkg		0.95			0.95
HP/Pkg		0.95	0.84	0.8	0.95
AC/Split-North	Ducted	0.95	0.85	0.8	0.95
	Ductless	1			1
AC/Split-SW, <45	Ducted	0.95			0.95
	Ductless	1			1
AC/Split-SW, >45	Ducted	0.95			0.95
	Ductless	1			1
HP/Split	Ducted	0.95	0.85	0.8	0.95
	Ductless	1	0.9	0.8	1
SDHV		1			1
		1	0.85	0.8	1
AC/SCP		0.98			0.98
HP/SCP		0.99	0.85	0.8	0.99

* Preliminary region IV to V adjustment

Residential Efficiencies (single phase <65K Btu/h)

The following table summarizes the changes and the increased levels

Product Class	Capacity	Metric	before 1/1/2023			Metric	after 1/1/2023			Improvement		
			National	Southern	Southwest		National	Southern	Southwest	National	Southern	Southwest
Split System	<65,000 Btu/h	SEER	13.0	14.0	14.0	SEER2	13.4	14.3	14.2	8.5%	7.5%	6.8%
		EER	-	-	12.2	EER2	-	-	11.7/9.8[d]			
		Pw,off	30.0	30.0	30.0	Pw,off	30.0	-	30.0			
	45,000 Btu/h to 65,000 Btu/h	SEER	13.0	14.0	14.0	SEER2	13.4	13.8	13.8	8.5%	3.8%	3.8%
		EER	-	-	11.7	EER2[e]	-	-	11.2/9.8[e]			
		Pw,off	30.0	30.0	30.0	Pw,off	30.0	30.0	30.0			
Split System Heat Pumps	<65,000 Btu/h	SEER	14.0	14.0	14.0	SEER2	14.3	14.3	14.3	7.5%	7.5%	7.5%
		HSPF	8.2	8.2	8.2	HSPF2	7.5	7.5	7.5	8.9%	8.9%	8.9%
		Pw,off	33.0	33.0	33.0	Pw,off	33.0	33.0	33.0			
Single Packaged	<65,000 Btu/h	SEER	14.0	14.0	14.0	SEER2	13.4	13.4	13.4	0.8%	0.8%	0.8%
		EER	-	-	11.0	EER	-	-	10.6			
		Pw,off	30.0	30.0	30.0	Pw,off	30.0	30.0	30.0			
Single Packaged Heat Pump	<65,000 Btu/h	SEER	14.0	14.0	14.0	SEER2	13.4	13.4	13.4	0.8%	0.8%	0.8%
		HSPF	8.0	8.0	8.0	HSPF2	6.7	6.7	6.7	-0.3%	-0.3%	-0.3%
		Pw,off	33.0	33.0	33.0	Pw,off	33.0	33.0	33.0			
Small Duct High Velocity	<65,000 Btu/h	SEER	12.0	12.0	12.0	SEER2	12.0	12.0	12.0	5.3%	5.3%	5.3%
		HSPF	7.2	7.2	7.2	HSPF2	6.1	6.1	6.1	0.9%	0.9%	0.9%
		Pw,off	30.0	30.0	30.0	Pw,off	30.0	30.0	30.0			
Space Contrained	<65,000 Btu/h	SEER	12.0	12.0	12.0	SEER2	11.7	11.7	11.7	2.6%	2.6%	2.6%
		Pw,off	30.0	30.0	30.0	Pw,off	30.0	30.0	30.0			
Space Contrained Heat Pump	<65,000 Btu/h	SEER	12.0	12.0	12.0	SEER2	11.9	11.9	11.9	4.4%	4.4%	4.4%
		HSPF	7.4	7.4	7.4	HSPF2	6.3	6.3	6.3	1.4%	1.4%	1.4%
		Pw,off	33.0	33.0	33.0	Pw,off	33.0	33.0	33.0			

d. The 11.7 EER2 standard applies to products with a certified SEER2 less than 15.2. The 9.8 EER2 standard applies to products with a certified SEER2 greater

e. The 11.2 EER2 standard applies to products with a certified SEER2 less than 15.2. The 9.8 EER2 standard applies to products with a certified SEER2 greater

New Test Procedure Impact

- degrades efficiency by about -5% (i.e., 14.2 SEER2 = 15 SEER)
- HSPF by about -16% (i.e., 7.5 HSPF2 = 8.9 HSPF)

Commercial Unitary Products

- The Commercial Unitary classification includes commercial rooftops, split systems and high duct velocity equipment for both air-cooled and water-cooled products
- In 2010 ASHRAE 90.1 changed the annualized metric from **IPLV to IEER but still maintained the EER**.
- DOE as per the Energy Policy Act also regulates the products and typically approves what ASHRAE 90.1 develops but is limited to one regulated metric.
- They conducted an ASRAC negotiate rule back in 2016 and agreed to change the DOE regulated metric from EER to IEER with an effective date of 1/1/2018. for air-cooled products but did not rule on water-cooled.
- In addition, as part of the ASRAC ruling it was also agreed to further increase the **IEER levels for air cooled products further with an effective date of 1/1/2023**
- The efficiency levels were included in the 2019 standard but with the **effective date of 1/1/2025**
- DOE levels are limited to the 65,000 to 760,000 Btu/h range
- As these are federal controlled efficiency levels, they preempt all state and local efficiency levels
- The water-cooled efficiency levels have not changed

DOE and the Industry just completed another ASRAC ruling for Unitary Air-Cooled Products and developed a totally new cooling metric call IVEC and a heating metric called IVHE which including higher rating statics, ventilation fan operating, crankcase heater power as well as revised rating conditions. Essential the metrics are total annualized capacity divided by annualized power. Effective date has not been defined but likely will be 2029

Commercial Unitary Cooling Efficiency

The following is the table a summary of the **cooling unit efficiency** changes for Commercial Air Cooled Unitary

Product Class	Size Category	Heat Section	Metric	>1/1/2018	>1/12023	>1/12025	Improvement
Air Conditioners, air cooled	<65,000 Btu/h (3 phase)	All	SEER	13.0	13.0	-	
			SEER2	-	-	13.4	8.5%
Space Constrained, air cooled	≤30,000 Btu/h (3 phase)	All	SEER	12.0	12.0	-	
			SEER2	-	-	11.7	16.1%
Small Duct High Velocity, air cooled	<65,000 Btu/h (3 phase)	All	SEER	12.0	12.0		
			SEER2			12.0	5%
AirConditioners, air cooled	≥65,000 Btu/h and <135,000 Btu/h	Electric	EER	11.2	11.2	11.2	0.0%
			IEER	12.9	14.8	14.8	14.7%
		All Other	EER	11	11	11	0.0%
			IEER	12.7	14.6	14.6	15.0%
	≥135,000 Btu/h and <240,000 Btu/h	Electric	EER	11	11	11	5.3%
			IEER	12.4	14.2	14.2	14.5%
		All Other	EER	10.8	10.8	10.8	0.0%
			IEER	12.2	12.2	14	14.8%
	≥240,000 Btu/h and <760,000 Btu/h	Electric	EER	10	10	10	0.0%
			IEER	11.6	11.6	13.2	13.8%
		All Other	EER	9.8	9.8	9.8	0.0%
			IEER	12.2	12.2	14	14.8%
	≥760,000 Btu/h	Electric	EER	9.7	9.7	9.7	0.0%
			IEER	11.2	11.2	12.5	11.6%
		All Other	EER	9.5	9.5	9.5	0.0%
			IEER	11	11	12.3	11.8%

New Test Procedure Impact

- degrades efficiency by about -5% (i.e., 14.2 SEER2 = 15 SEER)
- HSPF by about -16% (i.e., 7.5 HSPF2 = 8.9 HSPF)

DOE switched from EER to IEER in 2018 and adopted ASHRAE 2016 levels

Additional Efficiency increases in IEER go into effect in 2023

3 Phase SEER2 delayed to 2026

No change to water cooled efficiency requirements

Commercial Unitary Heat Pumps

Product Class	Size Category	Heat Section	Metric	>1/1/2018	>1/12023	>1/12025	Improvement
Air Conditioners, air cooled	<65,000 Btu/h (3 phase)	All	SEER	14.0	14.0	-	
			SEER2	-	-	14.3	7.5%
			HSPF	8.2	8.2		
			HSPF2			7.5	8.9%
Space Constrained, air cooled	≤30,000 Btu/h (3 phase)	All	SEER	12.0	12.0	-	
			SEER2	-	-	11.7	2.6%
			HSPF	7.4	7.4		
			HSPF2			6.3	1.4%
Small Duct High Velocity, air cooled	<65,000 Btu/h (3 phase)	All	SEER	12.0	12.0		
			SEER2			12.0	5%
			HSPF	7.2	7.2		
			HSPF2			6.1	0.9%
AirConditioners, air cooled	≥65,000 Btu/h and <135,000 Btu/h	Electric	EER	11	11	11	0.0%
			IEER	12.2	12.2	14.1	15.6%
			COP_{H47}	3.3	3.4	3.4	0.0%
			COP_{H17}	2.25	2.25	2.25	0.0%
		All Other	EER	10.8	10.8	10.8	0.0%
			IEER	12	12	13.9	15.8%
	≥135,000 Btu/h and <240,000 Btu/h	Electric	EER	10.6	10.6	10.6	5.3%
			IEER	11.6	11.6	13.5	16.4%
			COP_{H47}	3.2	3.3	3.4	3.0%
			COP_{H17}	2.05	2.05	2.05	0.0%
		All Other	EER	10.4	10.4	10.4	0.0%
			IEER	11.4	11.4	13.3	16.7%
	≥240,000 Btu/h	Electric	EER	9.5	9.5	9.5	0.0%
			IEER	10.6	10.6	12.5	17.9%
			COP_{H47}	3.2	3.2	3.2	0.0%
			COP_{H17}	2.05	2.05	2.05	0.0%
		All Other	EER	9.3	9.3	9.3	0.0%
			IEER	10.4	10.4	12.3	18.3%

Commercial Heat Pump cooling efficiencies are slightly lower than cooling only units

With growing interest in heat pumps commercial heat pumps are growing in interest

Dual fuel would have to comply with furnace efficiency and the heat pump would have to comply with the electric COP_H levels shown in the table

VRF Efficiency Requirements

- Table 6.8.1-8 and 6.8.1-9 address the minimum efficiencies for Variable Refrigerant Flow (VRF) products
- As 1/1/2023 the duct free VRF with a capacity <65,000 Btu will switch to the SEER2 metric and HSPF2 metric as of 1/1/2023 aligning with the same requirements as single-phase and three-phase products we just reviewed
- In 2018, DOE and the industry completed an ASRAC negating rule to revise the test procedure (TP) and Energy Conservation Standards (ECS) for VRF equipment, and the final term sheet was approved on Nov 5, 2019.
- A revised AHRI Standard 1230 for rating and testing VRF equipment was published on May 18, 2021, to reflect the term sheet.
- Several test procedure changes were made as a result of the ASRAC term sheet and the revised AHRI Standard.
  - **Requirements for a new Sensible Heat Ratio requirement at 100% and 75% load**
  - **Addition of a control's verification test requirement**
  - Change in the DOE air-cooled metric for >65,000 Btu/h from EER to IEER
- This change results in a **decrease in the EER by 4.2% to 6.7%** which has been implemented in the 2022 standard
- The changes would also have reduced the IEER minimum requirements by about 12% but as part of the ASRAC negotiation it was agreed to not change the ASHRAE 90.1 2019 IEER values so in effect the minimum efficiency levels have been **increased by 12%**

Overall the focus of the regulatory metrics initiatives are moving to part load and annualized metrics which are more representative of building operation

Other Efficiency Table Changes

- **Heat Pump Chillers in table 6.8.1-16**
  - In 2019 heat pump chiller efficiency requirements were added based on the new standard rating conditions defined in AHRI 550/590
  - For 2022 some minor technical corrections were made as well as changes to align with expanded rating conditions in AHRI 550/590
  - Overall, with electrification the use of large commercial air source and water source heat pumps is growing.

- **Commercial Dry Type Transformers in table 8.8.4**
  - Table 8.8.4 was updated to align with the 2019 revised DOE efficiency requirements

- **DOAS Equipment Defined in Tables 6.8.1-13 and table 6.8.1-14**
  - As a result of another ASRAC ruling the efficiency metric for **DOAS equipment** as defined in AHRI 920 was revised to change the metric from **ISMRE to ISMRE2** which include changes in external static and test procedures
  - This required a cross-walk and change in efficiency metrics
  - AHRI is also in the process of implementing a certification program and conversion to ISMRE2
  - This addendum did not make the 2022 publication as there was a technical error that required an addendum public review that was released for public review from 12/23/2022 to 1/22/2023
  - It will be important to convert to ISMRE2

- **Table 6.8.1-5 Furnace Tables**
  - The table was updated and **reformatted to improve the clarity**
  - No efficiency changes were made

Mechanical Mandatory Requirements

In Section 6, 7, and 10 several other mandatory changes have been included in ASHRAE 90.1-2022 Standard

- **Boiler Efficiencies** - New buildings with gas hot-water boiler systems for space heating with a total system input of at least 1,000,000 Btu/h but not more than 10,000,000 Btu/h shall have a minimum thermal efficiency of 90% (condensing) and shall have a return water temperature less than 120 F
- **Demand Control Ventilation** - The requirements for demand control ventilation were updated to be a function of climate zone, ventilation and if the space has energy recovery and are defined in a new table 6.4.3.8
- **Small Unit Setback Controls** - Section 6.4.3.3 includes an exception for off-hour controls in small units. However, this negates the requirements in 6.4.3.3.1 for residential spaces that typically have small HVAC units. The controls that have proven cost-effective and less complex to use in hotel and motel guest rooms are also suitable, and readily available, for use in apartments. This addendum adds requirements for these setback thermostats with a few exceptions.
- **Exception to Optimum Start for Residential Spaces** – An exception for residential space to the requirement for optimum start for systems with DDC control defined in Section 6.4.3.3.3. was added.
- **Garage Exhaust Ventilation** - This addendum modifies the garage ventilation requirements for spaces that have separate sections separated by solid walls to require separate exhaust systems and controls. This is so that vehicle activity in one section does not result in unnecessary exhaust is other sections, and it improves safety by ensuring controls are provided in each section.
- **Shaft Ventilation Damper Requirements** - A requirement for motorized dampers was added for shaft vents used for temperature control but with am exception allowing non-motorized in warm climate zones 0, 1, 2, and 3

Mechanical Mandatory Requirements

- **Chiller Efficiency and Freeze Protection Updates** - The requirements for **Kadj** to expand to cover higher temperatures used for data centers and expands the requirements for certification ratings for **freeze protected chillers to also include centrifugals**. Kadj is used to adjust the table 6.8.1-3 efficiency requirements to the application conditions for centrifugal chillers.
- **Insulation for Service Water Heating** - The piping insulation thickness requirements in Table 6.8.3-1 were developed primarily for space heating. This change created new tables for service water heating piping insulation in Section 7.4. The proposed changes are based typical Service Water Heating (SWH) operation and operating temperatures. This change also made some changes to the Section 6.8.3 - Piping Insulation Tables to clarify some of the footnote and requirements for non-steel pipe
- **Simplified Building Updates** - Currently, the Simplified Path (Section 6.3) is exempt from the requirements of Paragraph 6.4.1.5, Verification of Equipment Efficiencies. This change corrects this.
- **Ceiling Fan Efficiency -** This change aligns the requirements for large ceiling fans with section 1008 of the Energy Act of 2020. The Act requires large-diameter ceiling fans to have a CFEI greater than or equal to 1.00 at high speed and greater than or equal to 1.31 at 40 percent speed or the nearest speed that is not less than 40 percent speed.
- **Compressed Air Systems -** This addendum adds compressed air systems to ASHRAE 90.1 in Section 10 section 10.4.6. The change addresses compressed air thru the following areas;
  - Trim Compressors and Storage
  - Advanced Controls
  - Leak Testing
  - Monitoring
  - Pipe Sizing

  The addendum builds and expands on requirements implemented in Title 24

Mechanical Mandatory Requirements

- **Dehumidification Control** – ASHRAE 62.1 2019 implemented an off-hour dewpoint control limit of 60 F to control mold issues. ASHRAE 90.1 revised humidity language throughout the standard to improve and align with Std 62.1-2019. The changes also also addressed efficient humidification and dehumidification, with the goals of minimizing simultaneous heating and cooling and encouraging use of site recovered energy.
- **Service Water Heating Controls** - Both energy efficiency and building water safety must be considered when designing Service Water Heating Systems. To inform the users of the Standard of the balance, an informative note has been added to Section 7.4.4 stating the service water heating system control settings and operating temperatures should be determined by either the ASHRAE Standard 188, Legionnaires' Disease Risk Management for the building or with generally accepted engineering standards and guidelines such as ASHRAE Guideline 12. Both Standard 188 and Guideline 12 were be added to Informative Appendix E.
- **Guideline 36 Controls Reference** – ASHRAE Guideline 36, High-Performance Sequences of Operation for HVAC Systems, was created to develop and maintain best-in-class standardized HVAC control sequences. ASHRAE 90.1 was updated to make references to sequences of operation described in ASHRAE Guideline 36 in appropriate sections of Section 6 where control requirements are stated but lack specificity in how the sequences can be implemented.
- **Elevator Requirements** - The change made changes to improve elevator fan, lighting, and movement efficiency. Changes have been made to each subsection of Section 10.4.3 "Elevators," and the documentation requirements have been moved to a new subsection of Section 10.9.
  - Lighting efficacy has been increased from 35 to 50 lumens per watt.
  - Fan power metric (W/cfm) has been changed to fan efficacy (cfm/W) and reduced by 24%
  - Establishing a minimum energy efficiency target of E or better.

Mechanical Prescriptive Updates

In Section 6, 7, and 10 several other prescriptive changes have been included in ASHRAE 90.1-2022 Standard. Note that prescriptive may have options and can be traded off using performance options.

- **ERV Bypass Requirements** – In the prescriptive section 6.5.6 there are prescriptive requirements for the use of exhaust air energy recovery for use with ventilation air systems. Additional requirements were added to clarify the requirements for bypass when economizers are being used for both the outside air and exhaust air. The pressure drop is limited to 0.4 in water and there is an additional requirement to limit energy exchange to 10% when in bypass mode.
- **Exhaust Air Energy Recovery** - The current enthalpy recovery ratio (ERR) requirement has caused confusion when applied to systems that require only sensible heating energy recovery. For systems that do not provide humidification, there is no heating energy benefit due to latent energy recovery. This change added language to the standard to specify the sensible energy recovery ratio requirement for these systems.
- **DOAS Exemption** - This change adds an exception to the DOAS requirements in 6.5.2.6 for units that use only series energy recovery in climate zone 0A, 1a, 2a, 3a and 4a for reheating dehumidified air. The rationale for this section is that when the building needs sensible cooling energy, reheating of the ventilation airstream causes energy to be wasted, even with free condenser reheat.
- **Hospital Heat Recovery** - Section 6.5.6.3, “Heat Recovery for Space Conditioning” requires heat recovery to be used in most acute inpatient hospitals. The existing language refers to “condenser heat recovery.” The intention was that the heat source be the chilled water return. The use of the term “condenser heat recovery” has led some users to believe that the heat source can be water leaving the chiller condenser. While this method does recover heat, it does not reduce load on the chillers. The requirements were revised to clarify this in section 6.5.6.3.

Mechanical Prescriptive Updates

- **Economizer Trade-off** – In table 6.5.1-2 equipment efficiency level increases are defined to allow for the elimination of the mandatory required economizers is defined. A change was made to clarification the efficiency improvement for elimination of economizers
- **Expanded Airside Economizers** – Airside economizers can provide significant energy savings during lower temperature cooling which is common in commercial buildings. Currently the airside economizer requirement is required for all products above 54,000 Btu/h for both new and replacement equipment. In the 90.1-2022 the requirements for airside economizer is extended down to units with a **capacity of 33,000 Btu/h for individual fan-cooling units located outside the envelope of the building**.
- **Small Fan Efficacy** - This change establishes minimum fan efficacy requirements for low-power ventilation fans with a minimum cfm/W as listed in table 6.5.3.7
- **FEI Rating Clarification** – Changes were made to explicitly clarify the mandatory provisions for Fan Energy Index (FEI) for in-scope fans by adding “at its highest design airflow rate” in two places in Section 6.5.3.1.3, Fan Efficiency.
- **Occupied Standby** - The occupied-standby requirement in 90.1-2019 requires shutting off ventilation air to unoccupied zones. For single-zone systems, this saves fan energy and the thermal energy associated with conditioning outside air. For multiple-zone systems, the zone ventilation air is shut off, which reduces fan energy and reheat energy. But the current requirements do not explicitly require reset to the outdoor air amounts at the system level. This change adds requirements to correct this in section 6.5.3.8.1 Significant energy savings can be achieved by also resetting the minimum outdoor airflow set point at the air handler.

Mechanical Prescriptive Updates

- **Large Capacity Service Water Heater Requirements** - This change modifies Section 7.5.3, which sets minimum thermal efficiency (Et) requirements for high-capacity gas-fired water heaters in new buildings. The new requirements apply only when the total input capacity of that equipment exceeds 1,000,000 Btu/h (293 kW). Changes include the following:
  - Where a single high-capacity water heater supplies a system or there are multiple high efficiency water heaters suppling a single system, the minimum Et is now 92%.
  - Left unchanged is the requirement that when there is a mix of high- and standard-efficiency water heaters supplying a system, the total input-capacity-weighted Et must be 90% or higher, but the language has been revised for clarity.

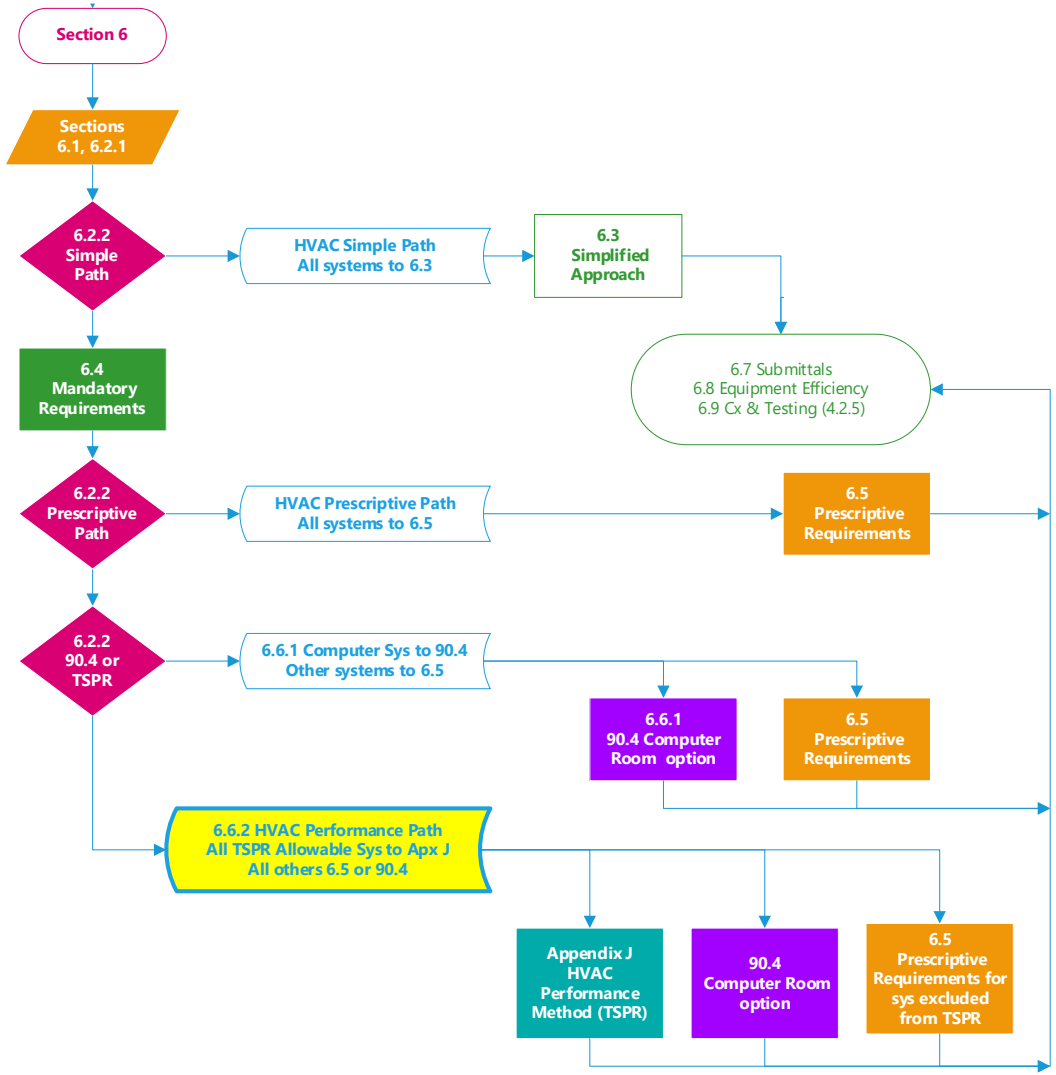
Mechanical Total System Performance Ratio (TSPR)

Michael Tillou

HVAC Total System Performance Ratio (TSPR)

Current HVAC paths

- Appendix G
- Section 12 (ECB)
- 6.3 Simplified Path
- 6.5 Prescriptive Path
- 6.6.1 Computer Room Path
- 6.6.2 HVAC System Performance (TSPR/J) Path



TSPR is a new performance-based compliance path for HVAC systems

HVAC Total System Performance Ratio (TSPR)

The Basic TSPR Idea

- Forget the question; “does it comply prescriptively?”
- Instead; how much Heating, Cooling can be delivered and at what cost per HVAC service? – This is TSPR
- Compare the proposed TSPR to a target TSPR
- Allows equivalent tradeoffs within HVAC prescriptive requirements

Why HVAC Performance?

- A particular building may have trouble with a prescriptive requirement
  - Trouble meeting fan power limits
  - Economizer difficult
- TSPR allows trade off within HVAC system
  - Higher cooling or heating efficiency
  - Pumping power reductions
  - More DCV area where not required
- TSPR results in equivalent energy input for a “good” system selection
- Reduces complexity of a whole building analysis

HVAC Total System Performance Ratio (TSPR)

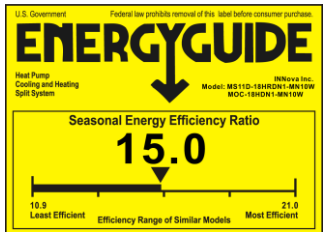
HVAC Performance Metric: Total System Performance Ratio

$$\textbf{TSPR} = \frac{\text{Heating + Cooling Loads Delivered}}{\textbf{Annual HVAC Operating Input*}}$$

* HVAC operating input can be in terms of energy cost (ECI), use (site or source Btu's), or carbon emissions. The higher the HVAC loads output relative to HVAC input, the more efficient the total HVAC system is.

Unlike a '**Mechanical Power Density**' limit, TSPR accounts for part load performance

TSPR is the HVAC system performance for the whole building HVAC system (more like a seasonal heat pump rating than boiler efficiency)



HVAC Total System Performance Ratio (TSPR)

Alignment with Appendix G Modeling Process

Compliance achieved when:

$$\textbf{TSPR}_{\textbf{proposed}} \text{ must be} \geq \textbf{TSPR}_{\textbf{reference}} / \text{MPF}$$

$$\text{MPF} = \frac{TSPR\ reference}{TSPR\ target}$$

- Proposed System – Your Building HVAC System
- Reference System – Aligned with Appendix G (ca. 2004)
- Target System – Aligned with prescriptive, but not worst option
- MPF – Mechanical Performance Factor

Building Area Type	Climate Zone		
	0A and 1A	0B and 1B	2A
Multifamily	0.68	0.70	0.66
Healthcare/	0.60	0.60	0.58

HVAC Total System Performance Ratio (TSPR)

Reference and Target Systems Details

Reference based on 90.1 Appendix G

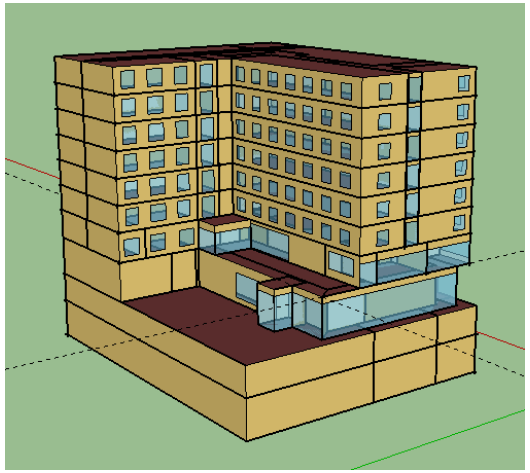
Target based on Current 90.1 Prescriptive and “good practice”

	Building Type Parameter	Large Office	Small Office	Retail	School	Hotel	Apartment
Reference	**System Type (Warm)**	VAV/ RH Water cooled chiller/ Elec RH	Packaged air-source Heat Pump; with air econo-ex CZ 1-2	Packaged air-source Heat Pump; with air econo-ex CZ 1-2	Packaged DX VAV/ Elec RH	Packaged terminal air-source Heat Pump	Packaged terminal air-source Heat Pump
	System Type (Cold)	VAV/ RH Water cooled chiller/ gas boiler	Packaged air-source AC / Furnace; with air econo	Packaged air-source AC / Furnace; with air econo	Packaged DX VAV/ Hydeonic RH/ gas boiler	Packaged terminal AC / Furnace	Packaged terminal AC / Furnace
Target	**System Type (Warm)**	VAV/ RH Water cooled chiller/ Elec RH	Packaged air-source Heat Pump; with air econo-ex CZ 1-2	Packaged air-source Heat Pump; with air econo-ex CZ 1-2	VAV/ RH Water cooled chiller/ Elec RH; ERV	Packaged terminal air-source Heat Pump	Split air-source Heat Pump w/ ERV
	System Type (Cold)	VAV/ RH Water cooled chiller/ gas boiler	Packaged air-source AC / Furnace; with air econo	Packaged air-source AC / Furnace; with air econo	VAV/ RH Water cooled chiller/ gas boiler; ERV	Packaged terminal AC / Furnace	Split air-source AC Gas Furnace / w/ERV

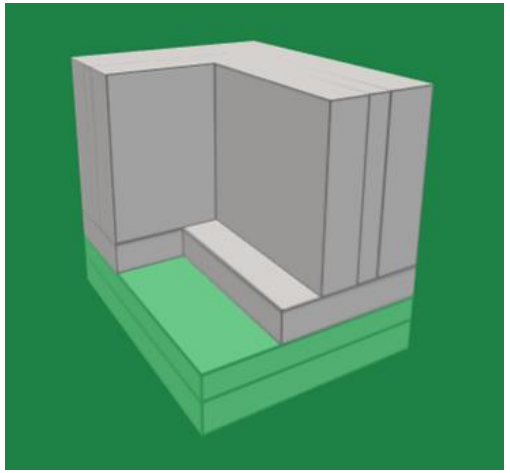
HVAC Total System Performance Ratio (TSPR)

Compliance Calculation Tool

- Based on code language outlining the ruleset
- New tool provided by DOE (free)
- Simplified tool for assessing building energy efficiency
  - Not a prototype approach, based on actual simplified building
- Uses default ASHRAE 90.1 Appendix C loads and schedules
- Lighting, equipment and envelope loads same as reference



Detailed Energy Model



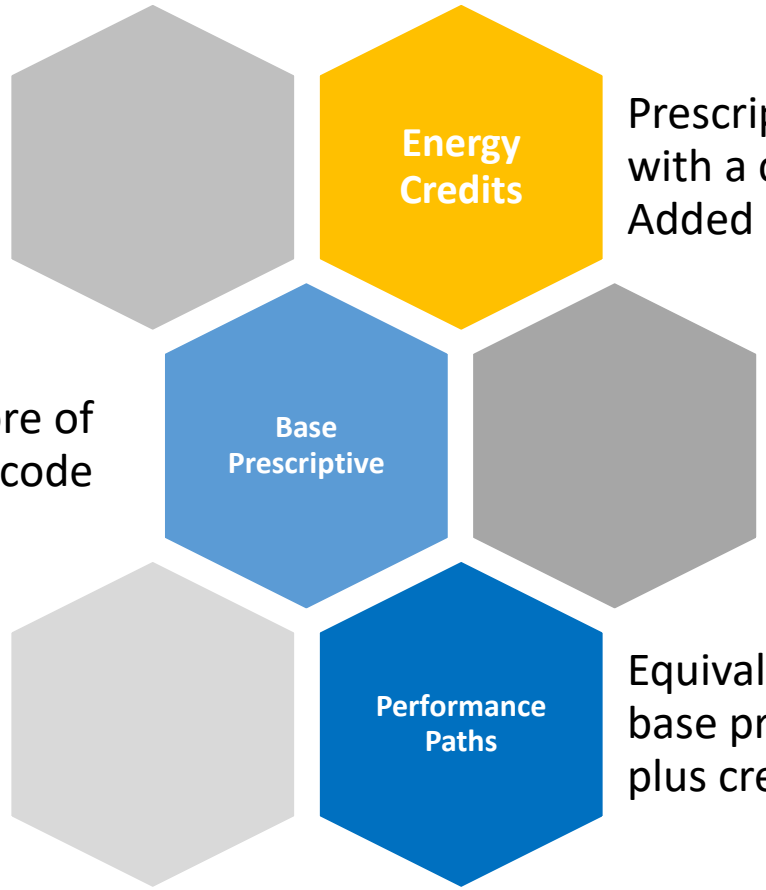
Block Based Simplified Model

Energy Credits Additional Requirements

Michael Tillou

Energy Credits

How Do Energy Credits Fit?



Prescriptive Plus: with a choice; Added Savings

The core of the code

Equivalent to base prescriptive plus credits

New energy credits language requires projects to select additional energy efficiency and load management design features to improve overall building energy efficiency.

Energy Credit Characteristics

- Wide range of credits
- May be experimental / new / load management
- Promotes improved HVAC efficiency
- Instead of prescriptive exceptions, pick an alternative savings target
- Rough equivalency across the different credits
- Can support above code or incentives

Energy Credits

Benefits of "Energy Efficiency Credits"

- Credit measures can offer more flexibility
  - Do not need to apply to all buildings
  - Niche oriented savings opportunities can be included
  - Does not require a custom performance analysis
  - Provides flexibility of choice to each project
- Can mix options to achieve a target savings
- Can include choices that may not be strictly cost effective
- Deal with large-saving strategies that may not be appropriate for all buildings
- Lays groundwork for future performance tradeoffs and target for smaller simple buildings

Energy Credits

Scope & Requirements

Scope:

- New buildings > 2000 sq. ft.
- Initial infill construction (>2000 sf)
- Additions > 2000 sq. ft.
- Substantial Alterations > 5000 sq. ft. that replace any 2 of:
  - HVAC heating or cooling equip.
  - 80% of lighting fixtures
  - Envelope cladding, insulation or fenestration
- Build Outs > 1000 sq.ft.
- Excluded:
  - Equipment & utility buildings
  - Industrial portions of factory buildings

Requirements:

- Meet required credit thresholds by building type and climate zone
- Select from available measures for building use type
- Half the required credits for:
  - Core & Shell
  - Initial infill construction
  - Unconditioned parking garages
  - Substantial Alterations and Build Outs

How credits are achieved:

- Table credits by building use
- Adjusted table credits
- Calculation (e.g., Appendix C)

Energy Credits

Energy Credit Requirements Table

Building Use Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Multifamily	50	50	50	50	50	50	46	50	50	48	50	46	50	50	49	50	50	50	50
Healthcare	50	50	50	50	50	50	50	50	50	46	46	50	50	50	50	50	50	50	50
Hotel/Motel	50	45	47	46	49	48	46	47	50	48	50	50	47	46	47	49	46	50	50
Office	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Restaurant	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Retail	50	50	50	50	50	50	50	50	50	50	50	50	49	50	47	48	45	42	46
Education	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	46
Warehouse	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Other	39	36	37	37	35	34	30	32	33	28	32	30	29	31	30	29	30	29	29

- Each Credit represents ~1/10 % whole building energy cost
- Limited to 50 credits or 5% building energy cost savings
- Measure points requirements selected to be cost effective and practical
- Renewable (PV) all now at 0.1 W/GSF in all climate zones
  - Adjustments provided if roof area not available or other PV exceptions
- Generally, certain climate zones or high intensity buildings have slightly reduced requirements
- “Other” buildings set at ~50% average requirement of analyzed buildings

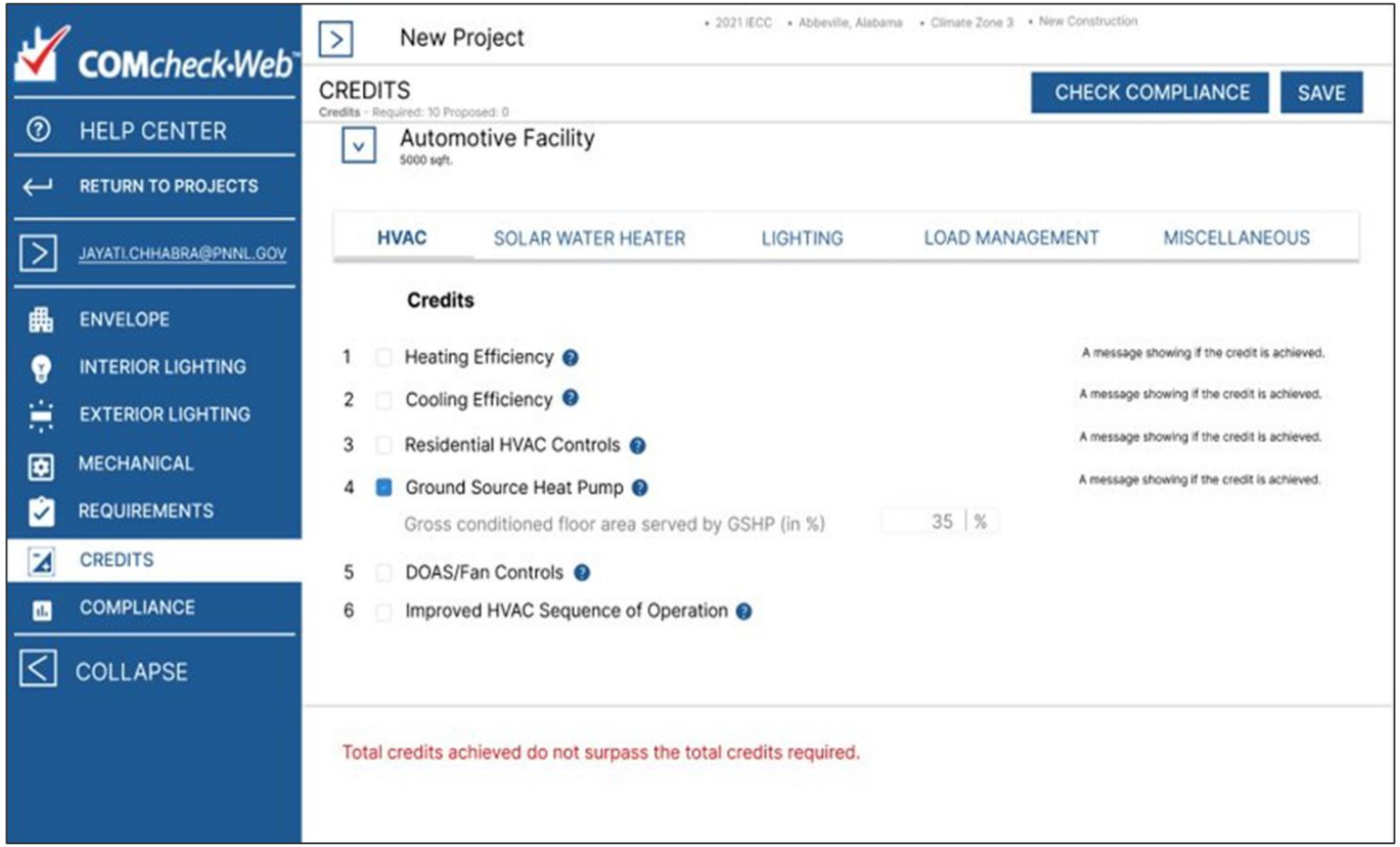
Energy Credits

Measures Include

- Envelope
  - Use Appendix C for: UA; SHGC; VT; Air barrier testing; WWR
- HVAC
  - 5%-15% cooling eff improve
  - 5%-15% heating eff improve
  - Residential master HVAC control
  - Ground source heat pump
  - DOAS/ERV with zone fan control
- Service water heating
  - Heat recovery (drain & preheat)
  - Efficient gas or heat pump WH
  - Improved temperature maintenance
    - Increase pipe insulation
    - Point-of-use water heaters
    - Thermostatic balancing valves
  - MF: SHW meters; Right pipe sizing
- Added Monitoring or FDD
- Lighting
  - Enhanced Dimming & Tuning
  - More occupancy sensor control
  - Increased daylight control area
  - Residential master light control
  - LPD reduced 5%-15%
- Added on-site renewable energy
- Efficient equipment
  - Elevator, Kitchen, FDD
- Peak load management
  - Lighting and HVAC response
  - Automated shading
  - Electric & cooling (ice) storage
  - SHW storage
  - Building mass & night flush

Energy Credits

Compliance using ComCheck



- New energy credit interface to facilitate data entry and feedback.
- ComCheck inputs for Envelope, Lighting, HVAC and Renewable energy will also populate Energy Credits
- ComCheck will indicate where additional energy credits have been earned.

Energy Credits

Summary

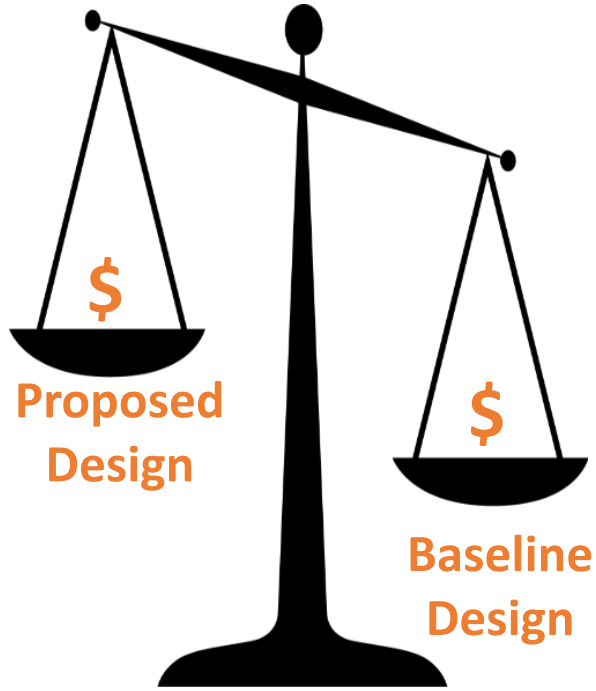
- The Energy Credits Proposal includes 32 energy saving measures
- Potential ~5% added energy savings
- Provides design flexibility
- Includes grid response
- Cost effectiveness was considered
- Developed with significant workgroup, public and 90.1 member input
- Solid and enforceable code language
- Integration into ComCheck Software

Whole Building Performance (Energy Cost Budget and Performance Rating Method (Appendix G)

Michael Rosenberg

Whole Building Performance Refresher

- Standard 90.1 Includes Two Whole Building Performance Path Options
  - Both compare the energy cost of a proposed building design to a baseline
  1. Energy Cost Budget (ECB), Section 12
     - Baseline systems and components are same as proposed building, but at minimum, current prescriptive efficiency (**dependent baseline**)
  2. Performance Rating Method (PRM), Appendix G
     - Baseline systems and components based on the architectural program and location of a building (**independent baseline**)
     - Baseline set at efficiency ~ equal to 2004 standard with proposed design required to exceed the baseline (**stable baseline**)



Standard 90.1-2022 Updates to Section 12 ECB and Appendix G (PRM)

- 33 Addenda Impacting Energy Cost Budget and Performance Rating Methods (Appendix G)
  - 6 addenda impacting only **E**nergy **C**ost **B**udget
  - 13 addenda impacting only **P**erformance **R**ating **M**ethod
  - 14 addenda impacting both ECB and PRM

Addendum bv – Updates to Building Performance Factors (PRM)

- Updates the Building Performance Factors (BPFs) used to determine compliance targets with the PRM
  - BPFs represent the improvement in regulated energy use between each edition of the standard and the 2004 baseline
  - Captures improvements in mandatory and prescriptive requirements in 2022
  - Uses a new approach more closely following PRM baseline rules
  - Results in most BPFs becoming **less stringent**

Addendum bv – Updates to Building Performance Factors (PRM) (continued)

2019 Building Performance Factors

Building Area Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Multifamily	0.68	0.7	0.68	0.7	0.66	0.66	0.69	0.68	0.59	0.74	0.76	0.74	0.7	0.73	0.75	0.68	0.71	0.68	0.72
Healthcare/hospital	0.6	0.6	0.6	0.6	0.58	0.54	0.56	0.55	0.55	0.55	0.54	0.54	0.57	0.52	0.54	0.57	0.52	0.57	0.57
Hotel/motel	0.55	0.53	0.55	0.53	0.53	0.52	0.53	0.54	0.54	0.53	0.53	0.52	0.5	0.51	0.51	0.5	0.51	0.5	0.5
Office	0.52	0.57	0.52	0.57	0.5	0.56	0.53	0.56	0.48	0.51	0.52	0.49	0.51	0.51	0.49	0.52	0.51	0.49	0.51
Restaurant	0.63	0.64	0.63	0.64	0.6	0.6	0.6	0.61	0.58	0.62	0.57	0.61	0.63	0.6	0.64	0.65	0.62	0.67	0.7
Retail	0.51	0.54	0.51	0.54	0.49	0.55	0.51	0.55	0.53	0.51	0.55	0.54	0.5	0.54	0.55	0.5	0.51	0.48	0.5
School	0.39	0.47	0.39	0.47	0.38	0.43	0.38	0.42	0.4	0.37	0.4	0.38	0.36	0.4	0.36	0.36	0.37	0.36	0.37
Warehouse	0.38	0.42	0.38	0.42	0.4	0.42	0.43	0.44	0.43	0.44	0.43	0.46	0.49	0.47	0.48	0.54	0.51	0.57	0.57
All others	0.56	0.57	0.56	0.57	0.5	0.52	0.5	0.54	0.53	0.53	0.52	0.54	0.51	0.51	0.5	0.5	0.5	0.5	0.46

2022 Building Performance Factors

Building Area Type	Climate Zone																		
	0A	0B	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Multifamily	0.69	0.68	0.71	0.7	0.72	0.72	0.71	0.76	0.63	0.69	0.76	0.71	0.66	0.72	0.71	0.65	0.67	0.65	0.67
Healthcare/hospital	0.69	0.69	0.7	0.68	0.67	0.65	0.65	0.66	0.64	0.64	0.66	0.63	0.67	0.65	0.65	0.66	0.67	0.68	0.7
Hotel/motel	0.66	0.66	0.69	0.65	0.65	0.64	0.64	0.65	0.65	0.63	0.65	0.63	0.62	0.63	0.62	0.61	0.62	0.59	0.58
Office	0.54	0.54	0.53	0.52	0.52	0.52	0.5	0.54	0.48	0.48	0.53	0.48	0.49	0.52	0.48	0.48	0.49	0.46	0.48
Restaurant	0.62	0.59	0.57	0.57	0.57	0.53	0.57	0.53	0.51	0.55	0.54	0.54	0.57	0.56	0.55	0.59	0.58	0.61	0.64
Retail	0.51	0.49	0.48	0.48	0.44	0.43	0.43	0.43	0.44	0.42	0.43	0.46	0.43	0.42	0.47	0.43	0.43	0.41	0.44
School	0.52	0.57	0.57	0.56	0.52	0.53	0.52	0.49	0.5	0.46	0.47	0.47	0.47	0.46	0.46	0.46	0.44	0.45	0.45
Warehouse	0.26	0.26	0.22	0.25	0.21	0.22	0.25	0.21	0.19	0.25	0.22	0.22	0.28	0.24	0.22	0.31	0.28	0.29	0.32
All others	0.62	0.6	0.62	0.59	0.55	0.51	0.53	0.52	0.55	0.53	0.52	0.55	0.53	0.53	0.56	0.54	0.54	0.54	0.54

Increase in stringency

Decrease in stringency

Addendum af - Lighting Clarifications to Ensure Consistency (PRM)

- Ensures that lighting power is determined using the same approach (Building Area Method versus Space-by-Space Method) when lighting system has not yet been designed
  - Building Area Method, only when space types are not known.
- Establishes retail lighting display adder in the baseline “same as proposed” up to prescriptive limits in Section 9.
- Removes part of Table G3.6 which established baseline lighting power for “non-tradeable” surfaces which are meant to be “same as proposed”

Addendum bd – Chiller Curves (ECB & PRM)

- Adds a new Normative Appendix J which includes sets of chiller curves for use in building energy modeling software to simulate chiller part-load performance in ECB and PRM
  - Provides consistency between compliance submittals
  - **Must** be used to represent baseline chiller integrated part-load value (IPLV)
  - **May** be used to represent proposed chiller performance when data is unavailable
  - Applies to simulation programs using “entering condenser water temperature” models
  - Includes three sets of curves for each category of chiller
    - Energy-input-ratio modifier as a function of temperatures (EIR-f-T)
    - Energy-input-ratio modifier as a function of part load ratio (EIR-f-PLR)
    - Capacity modifier as a function of temperatures (CAP-f-T).
  - Provides curve inputs for temperatures in both SI and IP units

Addendum ch – Alternative Metrics (PRM)

- Adds Informative Appendix I for using metrics other than energy cost for with the PRM
  - Can be used to support jurisdiction **electrification** and **decarbonization** policies
  - Alternative metrics include **site energy**, **source energy**, and **emissions**
  - Provides alternative Building Performance Factors (BPFs used to set performance targets in PRM) using default national conversion factors for each metric
  - Provides an approach for custom BPF calculation based on local conversion factors for each metric

Addendum ck/cp – Renewable Energy (ECB & PRM)

- Projects can use Section 12 or Appendix G to trade-off the prescriptive renewable requirement for greater energy efficiency
- Renewable systems in the Baseline either:
  - Get modeled using the same system configuration as the Proposed on-site renewable system, or
  - Get modeled using a default photovoltaic system when no system is included in the proposed design.
- The default renewable energy system for the Baseline is configured to align with the PV Watts default photovoltaic system configurations.

Addendum u– ECB Baseline HVAC System Cleanup (ECB)

- Moved Baseline HVAC equipment capacity requirements from the Supply Fan section (item c) to the Equipment Capacity section (item i) in Section 12.5.2.
- Reorganized equipment capacity requirements into a numbered list.
- Requires that Baseline HVAC systems always use an air-side economizer. This removed ambiguity with how to apply fluid economizers in certain circumstances.

Addendum ab - Baseline System Selection (PRM)

- Major re-write of the language describing how to select the Baseline HVAC System types. New language aligns with the original intent but reduces most of the ambiguity that existed with the old language.
- Clarifies the six building area types used to select Baseline HVAC System types. **Residential, Public Assembly, Heated-Only Storage, Retail, Hospitals & Other Non-residential**.
- Adds new term *Residential Associated HVAC zones* to describe certain non-residential space types that serve residential spaces. This new term helps clarify the proper selection of baseline HVAC systems.
  - *Corridors, stairwells, lobbies*

Addendum co – Retrofits (PRM)

- Increases the BPF for Substantial Alterations by 5%, relative to new construction, in order to better accommodate the use of Appendix G for these types of projects.
- Adds new language in section G3.3 to describe modeling rules for limited Alterations that do not qualify as substantial alterations.
  - In the Proposed Design systems to be retrofit are modeled per design documents while all other systems are modeled using existing conditions.
  - The Baseline is modeled the same as the Proposed Design except all systems to be retrofit are assumed to have minimally compliant efficiencies.
  - BPF value for limited alterations is assumed to be 1.0
- When modeling an existing building with an addition the BPF will now be based on an area-weighted calculation.

Addendum cr – Envelope Backstop (ECB & PRM)

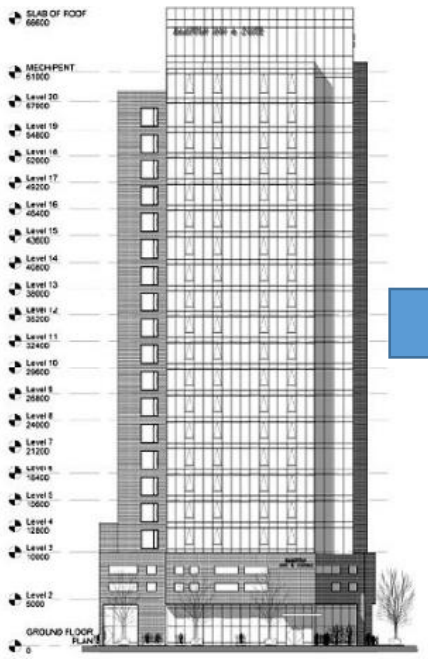
Background

- Once building is constructed, envelope is difficult or impossible to retrofit
- Prior to CR, Section 12 and Appendix G allowed unlimited “trade offs” between envelope and systems with much shorter equipment life
- Many adopters viewed it as a major loophole that allowed buildings with subpar envelope to pass code

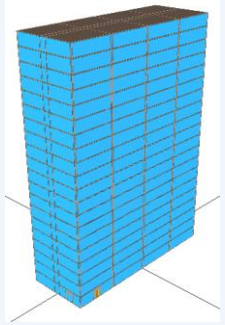
Selected Approach

- Based on 90.1 Envelope Trade-off Method
- Considers all aspects of the proposed envelope:
  - ✓ window area, U-factors, SHGC and VT;
  - ✓ opaque surfaces U-factor and thermal mass
  - ✓ orientation and attached shades
- Allows trade-offs between different aspects of the proposed envelope to preserve design flexibility
- Applies only to new construction projects

Addendum cr – Documenting Envelope Backstop (continued)



COMcheck™
DOE's Building Energy Codes Program



Proposed Envelope Performance Factor (PEPF)

- Specified envelope
- All other systems based on the prescribed defaults.

$ PEPF

Baseline Envelope Performance Factor (BEPF)

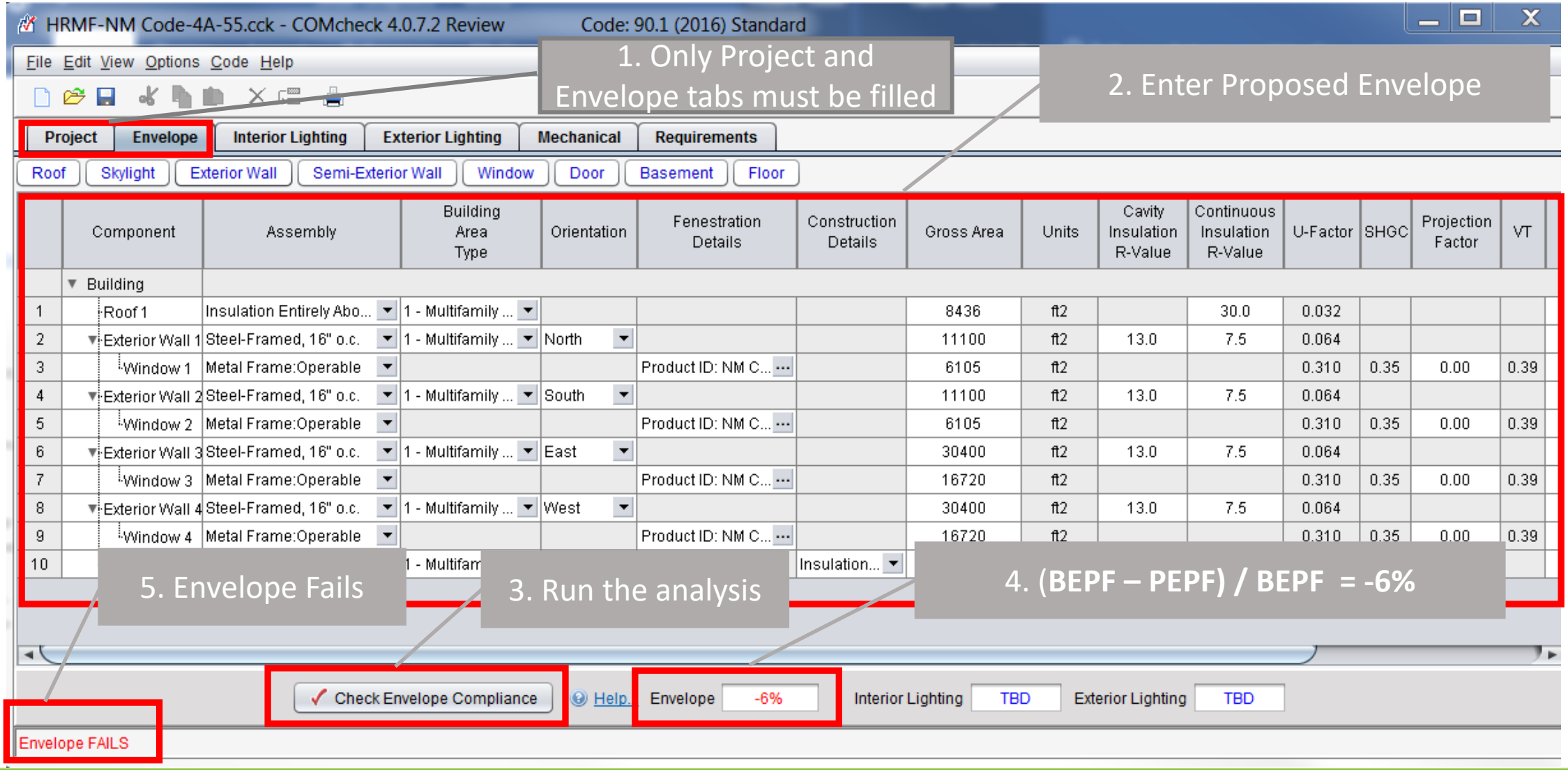
- Envelope complies prescriptively
- All other systems based on prescribed defaults.

$ BEPF

Project Passes If (PEPF/ $ BEPF)-1 <Backstop Value

Backstop value is set to 15% for residential occupancies and 7% for all other building types
In most cases, this allows buildings with up to 70% WWR and otherwise minimally code compliant envelope to pass

Addendum cr – **COMcheck Inputs**



	Component	Assembly	Building Area Type	Orientation	Fenestration Details	Construction Details	Gross Area	Units	Cavity Insulation R-Value	Continuous Insulation R-Value	U-Factor	SHGC	Projection Factor	VT
	▼ Building													
1	Roof 1	Insulation Entirely Abo...	1 - Multifamily ...				8436	ft2		30.0	0.032			
2	▼ Exterior Wall 1	Steel-Framed, 16" o.c.	1 - Multifamily ...	North			11100	ft2	13.0	7.5	0.064			
3	Window 1	Metal Frame:Operable			Product ID: NM C...		6105	ft2			0.310	0.35	0.00	0.39
4	▼ Exterior Wall 2	Steel-Framed, 16" o.c.	1 - Multifamily ...	South			11100	ft2	13.0	7.5	0.064			
5	Window 2	Metal Frame:Operable			Product ID: NM C...		6105	ft2			0.310	0.35	0.00	0.39
6	▼ Exterior Wall 3	Steel-Framed, 16" o.c.	1 - Multifamily ...	East			30400	ft2	13.0	7.5	0.064			
7	Window 3	Metal Frame:Operable			Product ID: NM C...		16720	ft2			0.310	0.35	0.00	0.39
8	▼ Exterior Wall 4	Steel-Framed, 16" o.c.	1 - Multifamily ...	West			30400	ft2	13.0	7.5	0.064			
9	Window 4	Metal Frame:Operable			Product ID: NM C...		16720	ft2			0.310	0.35	0.00	0.39
10			1 - Multifam			Insulation...								

Standard 90.1-2022 Updates to Section 12 ECB and Appendix G PRM - Other Addenda

- Other Addenda
  - Addendum db – Clarifications for determining base space conditioning categories (PRM)
  - Addendum h – Clarifies procedure for area weight BPFs for mixed use buildings (PRM)
  - Addendum l – Clarifies how fenestration is apportioned in the baseline building (PRM)
  - Addendum aa – Fixes inconsistencies in SI version for fan power and italicizes “on-site” (PRM)
  - Addendum aj – Clarifies that transformers falling between size ranges in Table 8.4.4 shall use linear interpolation for baseline efficiency (PRM)
  - Addendum an – Clarifies and consolidates requirements for fan system operation (PRM)
  - Addendum be – Updates Standard 140 required testing for simulation programs (ECB & PRM)
  - Addendum bg – Expands applicability to buildings sites and properties in accordance with general expansion of Standard 90.1 scope (ECB & PRM)
  - Addendum bh – Updates the temperature COP for PV baseline systems for consistency with PV Watts (ECB)
  - Addendum bt – Requires baseline CW and HW pumps to run only when load exists (PRM)
  - Addendum bu – Informative note recommending the use of ASHRAE Standard 209 (ECB & PRM)

Standard 90.1-2022 Updates to Section 12 ECB and Appendix G PRM - Other Addenda

- Other Addenda
  - Addendum cq – Changes “water cooled” to “fluid cooled” and other minor edits (PRM)
  - Addendum cs – Requires baseline high-capacity gas boilers to meet increased efficiency and baseline SWH equipment to meet prescriptive requirements (ECB)
  - Addendum ct – Clarifies how WWR is determined; specifies baseline does not include automatic shading, removed redundant reference to roof albedo
  - Addendum da – Aligns PRM documentation simulation program requirements with ECB (PRM)
  - Addendum i – Provide exception from baseline energy recovery requirements for labs with >15,00 cfm exhaust (PRM)
  - Addendum k – Eliminates baseline fan power credit for energy recovery when energy recovery is not in the baseline design (ECB)
  - Addendum v – Clarifies the documentation (including simulation file) which are submitted to AHJ (ECB & PRM)
  - Addendum w – Clarifies baseline chiller are sized based on peak coincident load (PRM)
  - Addendum s – Establishes solar reflectance requirements for baseline walls (ECB)
  - Addendum t – Specifies requirements for simulating envelope air leakage in baseline and proposed building (ECB & PRM)
  - Addendum ad – Renumbers reference sections for consistency with changes to other sections (ECB & PRM)
  - Addendum av – Specifies how thermal bridges are modeled in the baseline and proposed designs (ECB & PRM)

Questions

All

THANKS

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