2021 WSEC-C Compliance Using The C407 Total Building Performance Path

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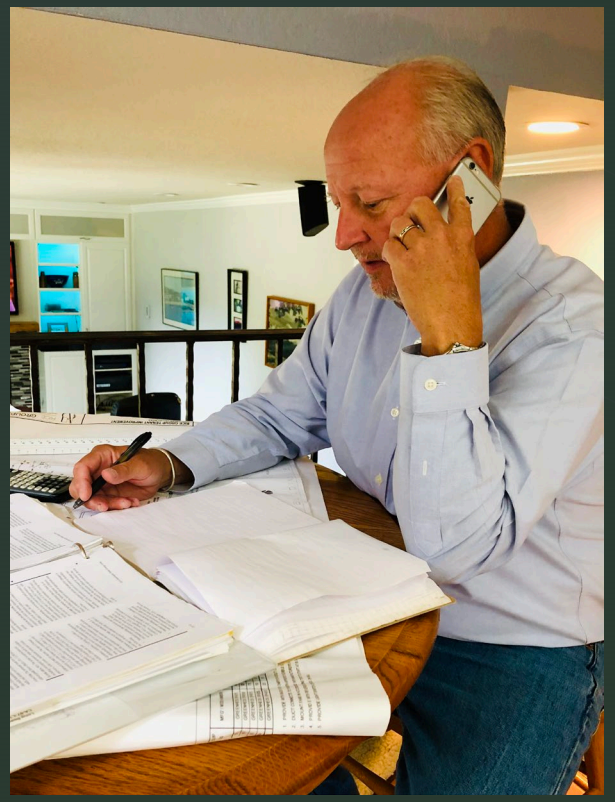

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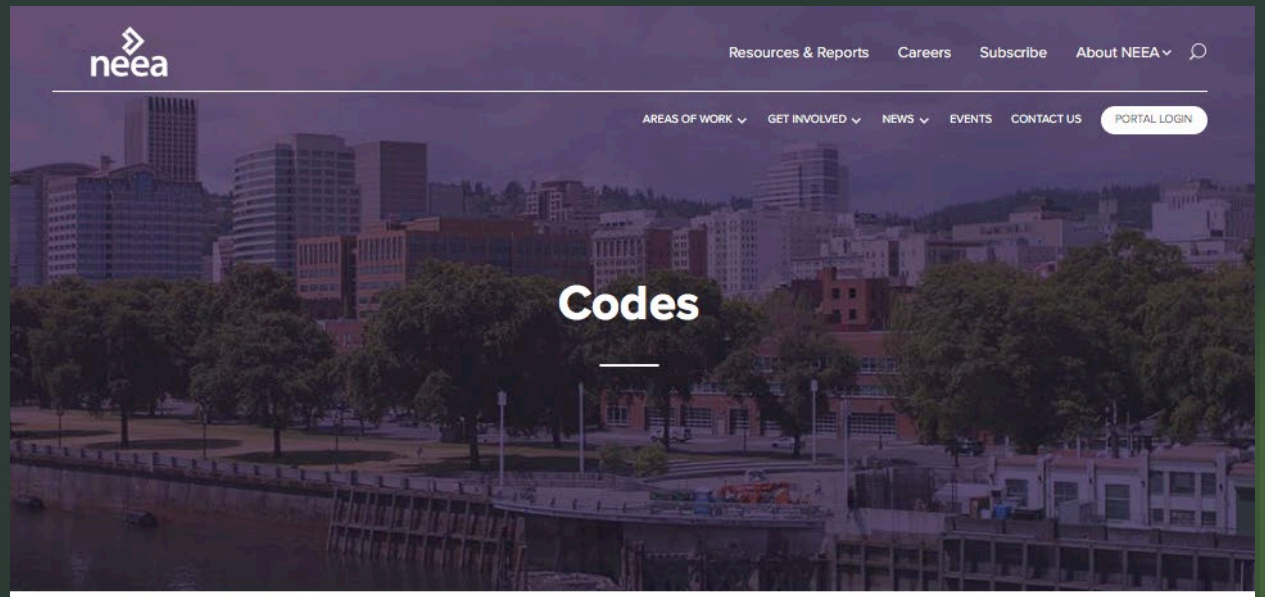

Increasing progressive effectiveness of energy codes

The NEEA Codes and Standards program supports regional stakeholders in the development and adoption, training and implementation of energy codes. States engage in the code development process along different cycles and code versions, but all states now use the International Energy Conservation Code (IECC) as a baseline for their commercial energy codes. All states except Oregon now use the IECC as the basis of their residential code. The adoption of codes is the responsibility of state code boards or agencies. Official state-by-state energy code information can be found on state building code websites:

Idaho - http://dbs.idaho.gov/boards/index.html

Oregon - http://www.cbs.state.or.us/external/bcd/

Washington - https://sbcc.wa.gov/

Montana - http://svc.mt.gov/gov/boards/

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WSEC technical support services are made possible thanks to the generous support of the Northwest Energy Efficiency Alliance

www.neea.org

Today's Presentation

- This presentation represents ETC's ***unofficial*** interpretation of WA State Energy Code intent.
- Our technical support team is not an affiliate, nor do we speak for the Washington State Building Code Council (SBCC).
- The WSEC commercial technical support we provide is advisory only and non-binding.

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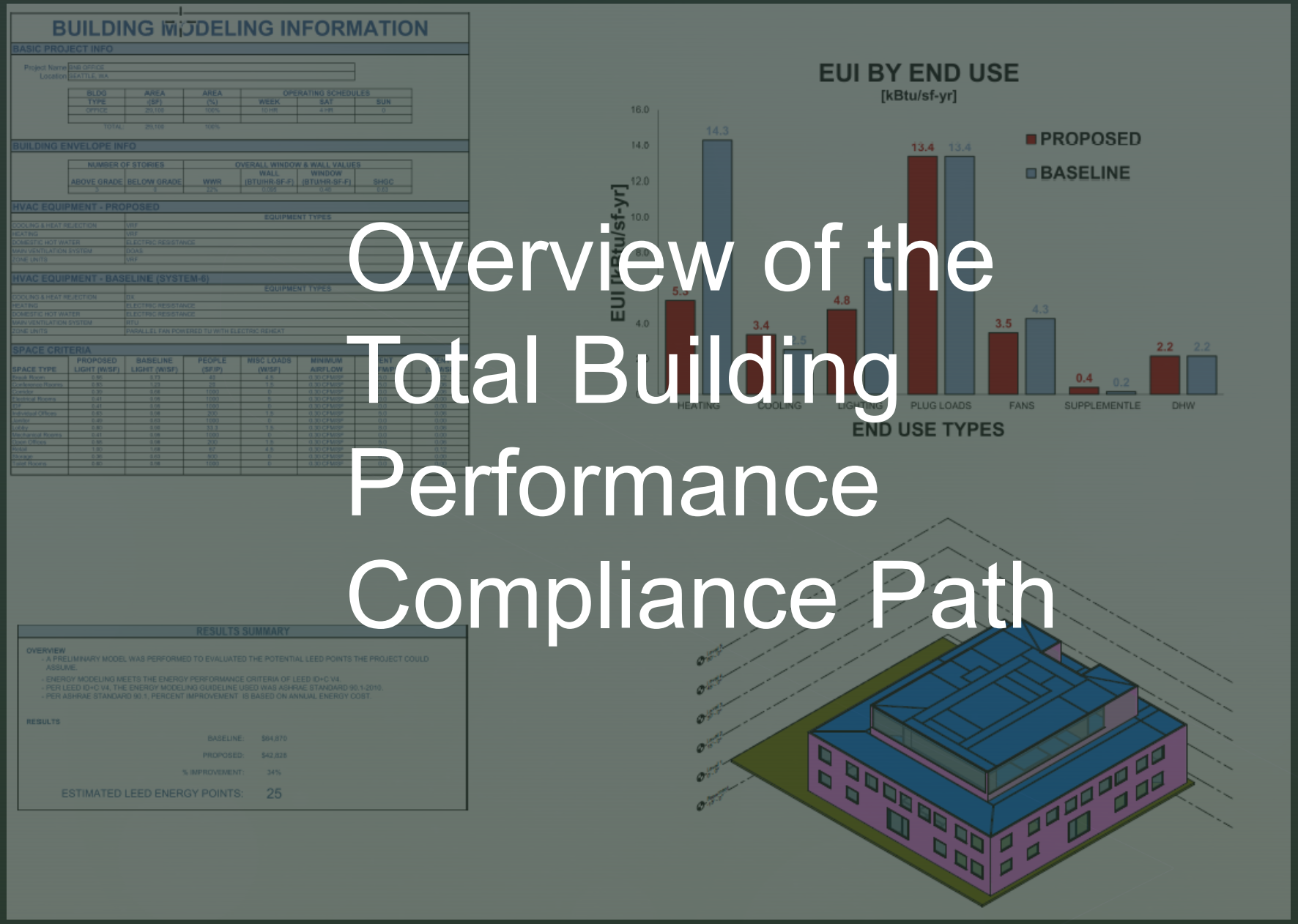
Topics we'll discuss today ~

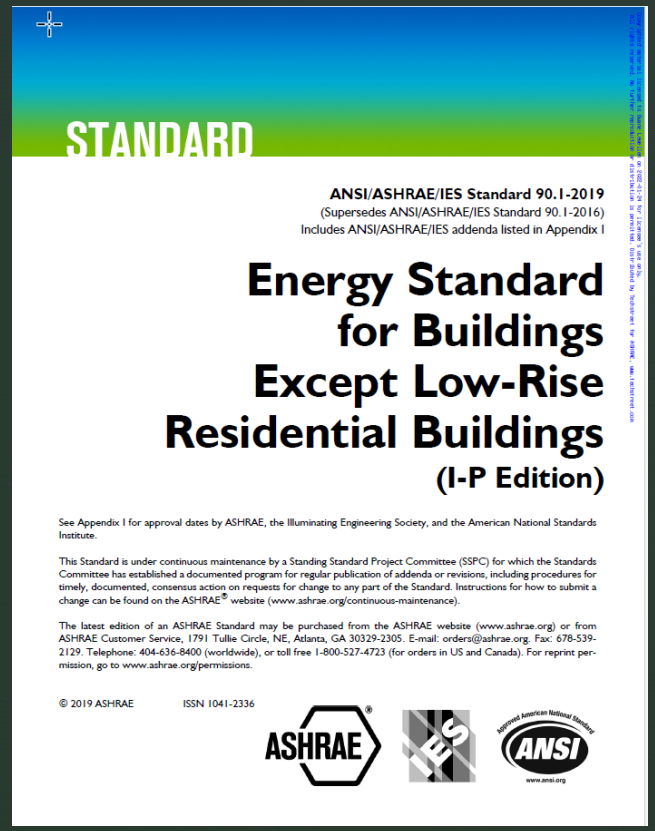
1. Overview of the C407 Total Building Performance compliance path
2. Mandatory compliance requirements
3. Provisions that are not required
4. When to consider using the C407 compliance path
5. Project types that can use the C407 compliance path
6. C407 documentation requirements
7. Live Q&A

Overview of the Total Building Performance Compliance Path



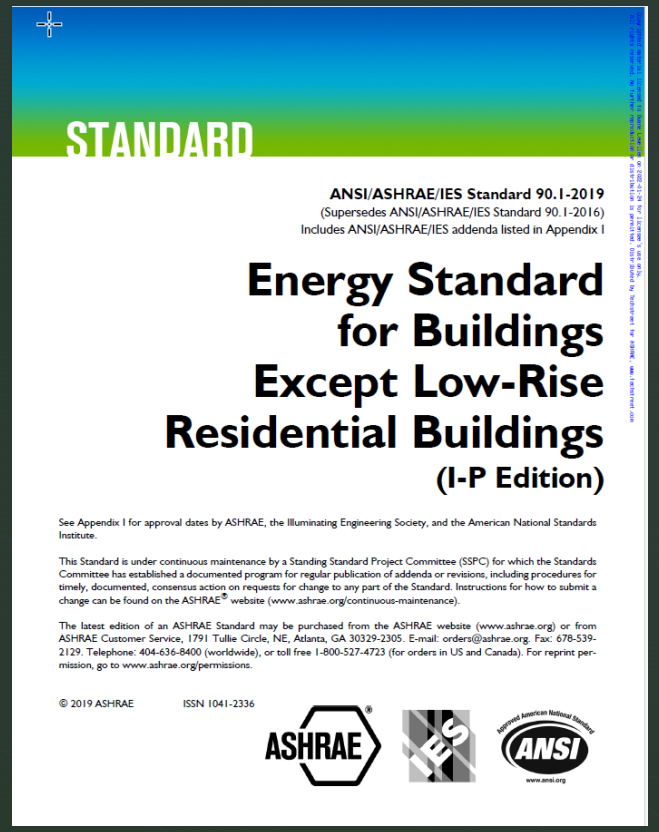
What is the C407 Compliance Path?

- Use of a whole building or tenant-level computer energy model to demonstrate compliance with the WSEC.
- Energy modeling protocol based on ASHRAE Standard 90.1-2019 Appendix G Performance Rating Method
- Energy modeling software shall comply with ASHRAE 90.1-2019 requirements.



What is the C407 Compliance Path?

- Energy saving strategies that cannot be modeled are allowed to use the “exceptional calculation method” for claimed savings
- Exceptional calculation method – Calculation tools/worksheets to determine estimated energy savings. Results are added to the modeled energy savings.
- Examples - ENERGY STAR appliances, refrigeration systems, high efficiency UPC systems, renewable energy systems



What is the C407 Compliance Path?

- Energy modeling results of the reference building (equivalent to ASHRAE Standard 90.1-2004) are compared to the results of the proposed building (as designed conditions).
- Building Performance Factors (BPF) are applied to the reference building for comparison to the proposed building.
- ***WSEC-C compliance requires meeting both a regulated site energy target and a total site energy reduction target.***

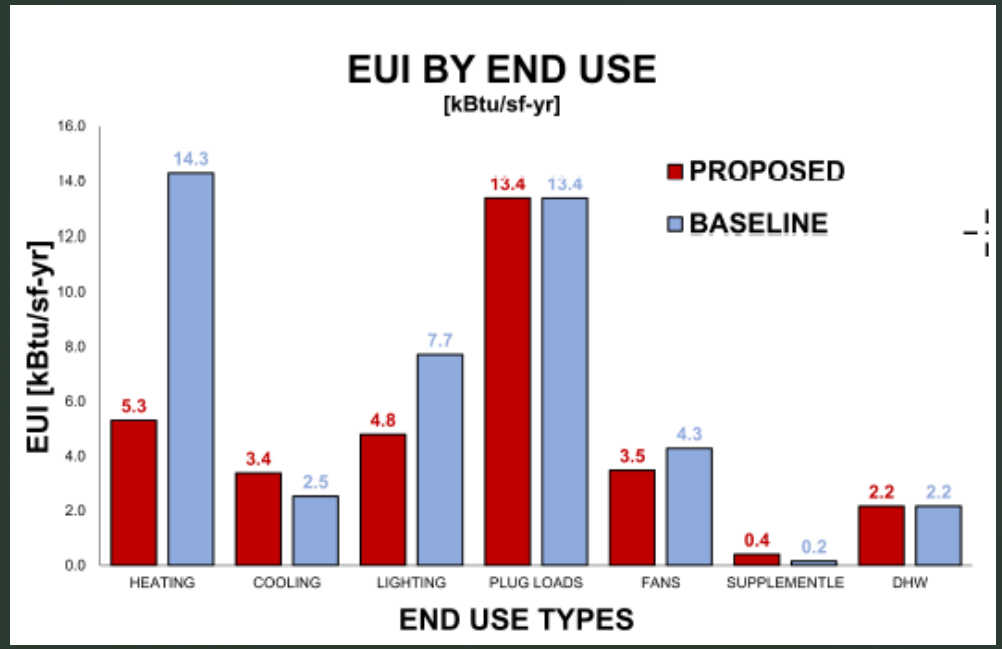
NOTE: Energy used to recharge or refuel vehicles used for transportation is exempt from the C407 requirements.

Regulated Site Energy Target

Focus on regulated load energy efficiency

Regulated Energy Loads

- HVAC
- Lighting
- Service water heating
- Motors
- Transformers
- Vertical transportation
- Refrigeration equipment
- Computer room cooling



Regulated Site Energy Building Performance Factor

Regulated site energy target

- Does not include on-site and off-site renewable energy production ***OR*** unregulated energy loads
- Reference building energy model results are multiplied by the BPF to determine the proposed building performance target.

Table C407.3(2)
Building Performance Factors (BPF) to be used for Compliance with Section C407.3

Building Area Type	Building Performance Factor
Multifamily	0.51
Health care/hospital	0.70
Hotel/motel	0.51
Office	0.44
Restaurant	0.33
Retail	0.41
School	0.35
Warehouse	0.18
All others	0.43

Total Site Energy Target

Includes contribution of renewable energy and improvements in unregulated loads

Unregulated Energy Loads

- Receptacles
- IT equipment
- Commercial cooking equipment

PVWatts Calculator

RESULTS

129,045 kWh/Year*

System output may range from 123,857 to 133,742 kWh per year near this location.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)
January	2.28	6,490
February	3.29	8,459
March	4.10	11,308
April	5.28	13,350
May	5.45	13,793
June	6.02	14,444
July	6.52	15,992
August	5.58	13,803
September	4.81	11,741
October	3.25	8,600
November	2.23	5,917
December	1.87	5,149
Annual	4.22	129,046

Total Site Energy Building Performance Factor

Total site energy target

- Reference building energy model results plus unregulated loads multiplied by the BPF to determine the total site energy building performance target.

Table C407.3(3)
Site Energy Performance Targets to be used for Compliance with Section C407.3

Building Area Type	Site Energy Performance Targets
Multifamily	0.59
Health care/hospital	0.72
Hotel/motel	0.62
Office	0.58
Restaurant	0.59
Retail	0.46
School	0.52
Warehouse	0.29
All others	0.55

C407 Total Building Performance Compliance

The Proposed building energy model shall demonstrate compliance with ***BOTH*** the regulated energy target and site energy target.

AND

All mandatory requirements listed in Table C407.2

C407 Mandatory Requirements

TABLE C407.2
MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD

Section[a]	Title	Comments
	Envelope	
C401	Thermal envelope certificate	
C402.2.7	Airspaces	
C402.5	Air Leakage	
	Mechanical	
C403.1.2	Calculation of heating and cooling loads	
C403.1.3	Data centers	
C403.2	System design	
C403.3.1	Equipment and system sizing	
C403.3.2	HVAC equipment performance requirements	
C403.3.3	Hot gas bypass limitation	
C403.3.4.4	Boiler turndown	
C403.4.1	[illegible] controls	
C403.4.2	[illegible] controls	
C403.4.7	[illegible] heating equipment [illegible]	
C403.4.8	Group R-1 hotel/motel guestrooms	See Section C403.7.4
C403.4.9	Group R-2 and R-3 dwelling units	
C403.4.10	Group R-2 sleeping units	
C403.4.11	Demand control ventilation (DCV)	
C403.4.15	Economizer fault detection and diagnostics (FDD)	
C403.7	Ventilation and exhaust systems	Except for C403.7.6
C403.8	Fan and fan controls	
C403.9.1.1	Variable flow controls	For cooling tower fans ≥ 7.5 hp
C403.9.1.2	Limitation on centrifugal fan cooling towers	For open cooling towers
C403.10	Construction of HVAC elements	
C403.11	Mechanical systems located outside of the building thermal envelope	
C403.14	Commissioning	
	Service Water Heating	
C404	Service Water Heating	Except for C404.2.1
	Lighting and Electrical	
C405	Electrical power and lighting systems	
	Other Requirements	
C407	Total Building Performance	
C408	System commissioning	
C409	Energy metering	
C410	Refrigeration requirements	
C411[b]	Renewable energy	
C412	Compressed air systems	

a. Reference to a code section includes all the relative subsections except as indicated in the table.
b. Compliance with any of these sections includes compliance with any exception to that section.

C407 Mandatory Requirements

Projects shall comply with the mandatory compliance measures listed in Table C407.2 ***IN ADDITION TO*** complying with the required energy modeling results requirements.

- Envelope
- Mechanical
- Service Water Heating
- Lighting and Electrical
- Other Requirements

TABLE C407.2
MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD

Section[a]	Title	Comments
	Envelope	
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C403.2	System design	
C403.3.1	Equipment and system sizing	
C403.3.2	HVAC equipment performance requirements	
C403.3.3	Hot gas bypass limitation	
C403.3.4.4	Boiler turndown	
C403.4.1	Thermostatic controls	
C403.4.2	Off-hour controls	
C403.4.7	Combustion heating equipment controls	
C403.4.8	Group R-1 hotel/motel guestrooms	See Section C403.7.4
C403.4.9	Group R-2 and R-3 dwelling units	
C403.4.10	Group R-2 sleeping units	
C403.4.11	Direct digital control systems,	
C403.5.5	Economizer fault detection and diagnostics (FDD)	
C403.7	Ventilation and exhaust systems	Except for C403.7.6.2
C403.8	Fan and fan controls	
C403.9.1.1	Variable flow controls	For cooling tower fans ≥ 7.5 hp
C403.9.1.2	Limitation on centrifugal fan cooling towers	For open cooling towers
C403.10	Construction of HVAC elements	
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C403.14	Commissioning	
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C404	Service Water Heating	Except for C404.2.1
	Lighting and Electrical	
C405	Electrical power and lighting systems	
	Other Requirements	
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b. Compliance with any of these sections includes compliance with any exception to that section.

C407 Envelope Mandatory Requirements

- Thermal envelope certification and documentation
- Documentation for airspace insulation values
- Air leakage testing and compliance
- UA Calculations – Total UA of the proposed building shall be no more than 20% higher than the Allowed Total UA

TABLE C407.2
MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD

Section[a]	Title	Comments
Envelope		
C401	Thermal envelope certificate	
C402.2.7	Airspaces	
C402.5	Air Leakage	

C407 Mechanical Mandatory Requirements

HVAC equipment performance

- Minimum equipment efficiency performance
- Fan power limits
- Various equipment type requirements

TABLE C407.2
MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD

C403.1.2	Calculation of heating and cooling loads	
C403.1.3	Data centers	
C403.2	System design	
C403.3.1	Equipment and system sizing	
C403.3.2	HVAC equipment performance requirements	
C403.3.3	Hot gas bypass limitation	
C403.3.4.4	Boiler turndown	
C403.3.6	Ventilation for Group R occupancy	
C403.4.1	Thermostatic controls	
C403.4.2	Off-hour controls	
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C403.9.1.2	Limitation on centrifugal fan cooling towers	For open cooling towers
C403.10	Construction of HVAC elements	
C403.11	Mechanical systems located outside of the building thermal envelope	
C403.14	Commissioning	

C407 Mechanical Mandatory Requirements

Mechanical system controls

- Thermostatic controls
- Load and occupancy-based controls
- Variable fan speed and pump flow controls
- Specific controls for Group R occupancies
- Economizer fault detection
- Direct digital control systems

TABLE C407.2 MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD		
C403.1.2	Calculation of heating and cooling loads	
C403.1.3	Data centers	
C403.2	System design	
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C403.11	Mechanical systems located outside of the building thermal envelope	
C403.14	Commissioning	

C407 Mechanical Mandatory Requirements

Ventilation & exhaust systems

- IMC Chapter 4 minimum ventilation & exhaust airflows
- Shut-off dampers
- Kitchen & lab exhaust system requirements
- Parking garage & loading dock exhaust
- Balanced ventilation and energy recovery for Group R occupancies

TABLE C407.2
MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD

C403.1.2	Calculation of heating and cooling loads	
C403.1.3	Data centers	
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C403.10	Construction of HVAC elements	
C403.11	Mechanical systems located outside of the building thermal envelope	
C403.14	Commissioning	

C407 Mechanical Mandatory Requirements

Ductwork & piping

- Ductwork construction requirements
- Ductwork insulation
- Hydronic and refrigerant piping insulation

Commissioning

- System testing & balancing

TABLE C407.2
MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD

C403.1.2	Calculation of heating and cooling loads	
C403.1.3	Data centers	
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C403.11	Mechanical systems located outside of the building thermal envelope	
C403.14	Commissioning	

C407 Service Water Heating Mandatory Requirements

Shall comply with all mandatory requirements ***EXCEPT Section C404.2.1***

- Minimum SWH equipment efficiency performance
- Efficient distribution system design
- SWH piping insulation
- Circulation system pumps & controls

Exempt from the requirement that at least 50% of SWH capacity be provided by heat pump water heater (HPWH)

TABLE C407.2
MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD

Service Water Heating		
C404	Service Water Heating	Except for C404.2.1

C407 Electrical Power and Lighting Mandatory Requirements

Shall comply with all mandatory requirements

- Automatic occupancy sensing, time switch and daylight responsive controls
- Interior lighting power allowance
- Exterior lighting power allowance
- Electrical transformers
- Dwelling unit electric metering
- Elevators and escalators
- Automatic receptacle controls

TABLE C407.2
MANDATORY COMPLIANCE MEASURES FOR TOTAL BUILDING PERFORMANCE METHOD

Lighting and Electrical		
C405	Electrical power and lighting systems	

C407 Other Mandatory Requirements

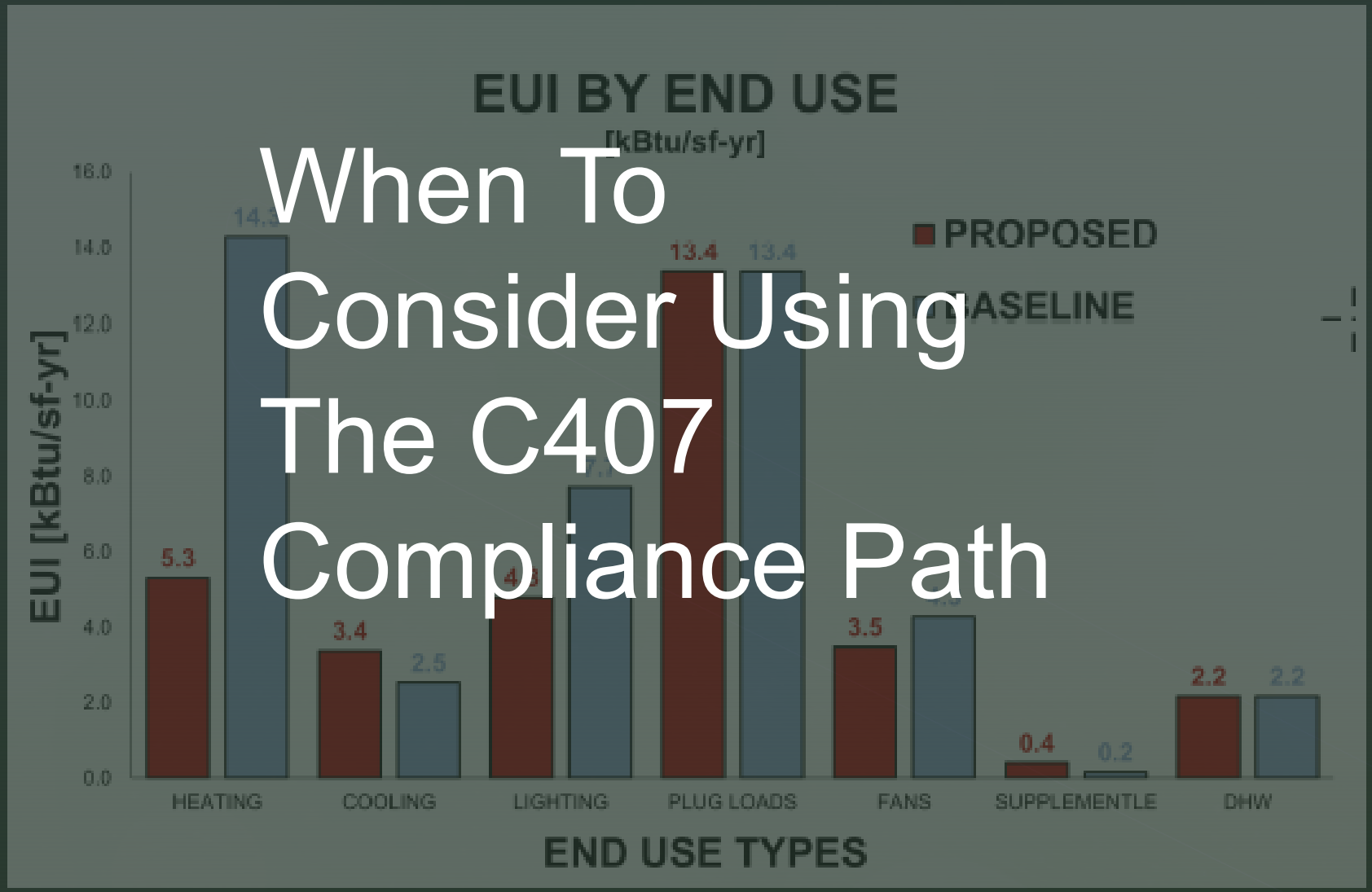
- C407 Total building performance
- C408 System commissioning
- C409 Energy metering
- C410 Refrigeration requirements
- C411 Renewable energy *
- C412 Compressed air systems

* C411 Renewable Energy includes compliance with any C411 exceptions.

Review: Provisions That Are Not Mandatory When Using C407 Compliance Path

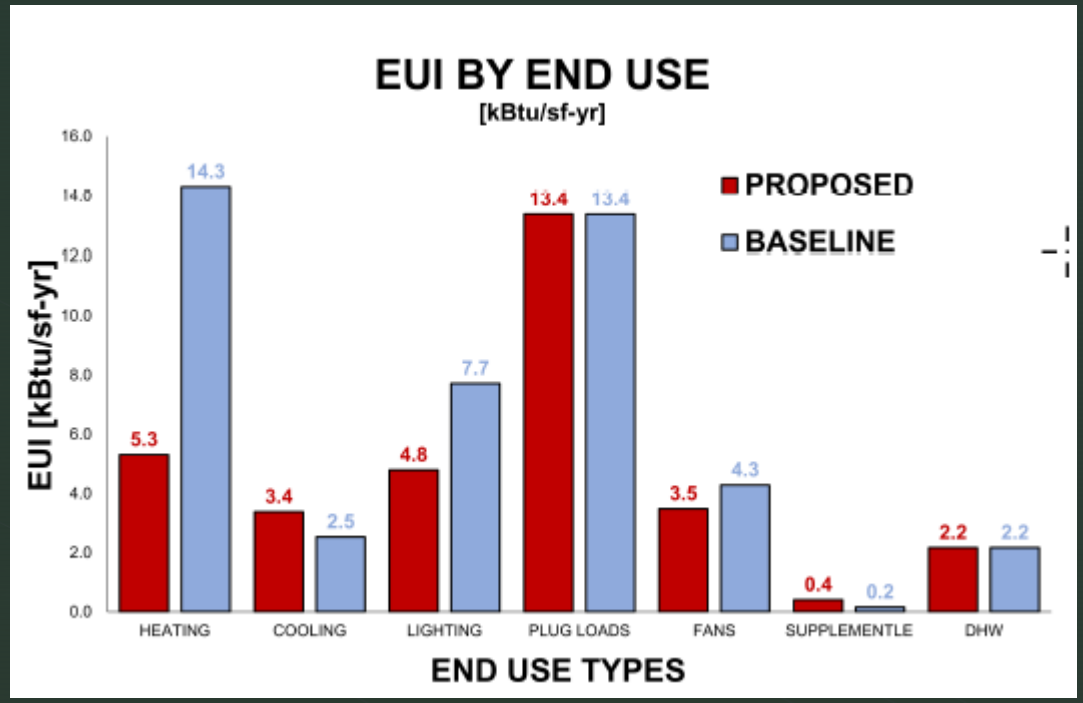
- C402.1 Prescriptive building thermal envelope requirements
- C403.1.1 HVAC total system performance ratio (TSPR)
- C403.1.4 Use of electric resistance & fossil fuel-fired HVAC heating equipment
- C403.3.5 Dedicated outdoor air systems (DOAS)
- C403.5 Economizers
- C403.7.6 Ventilation system energy recovery (other than Group R occupancies)
- C403.9.2 Heat recovery (exhaust, condenser, condensate & process systems)
- C404.2.1 Service water heating system type (HPWH)
- C406.1 Additional energy efficiency & load management credits

When To Consider Using The C407 Compliance Path



C407 Compliance Advantages

- “Whole Project” performance approach that allows energy trade-offs between all building systems (envelope, mechanical, lighting, SWH)
- Accounts for on-site and off-site renewable energy production
- Claim energy savings from unregulated energy saving strategies
- Claim energy savings from connection to high efficiency district energy systems



When to Use the C407 Compliance Path

- Proposed envelope UA does not comply and is within 20% of the Target UA.
- Trade-off economizer cooling with other energy saving strategies.
- Unable to comply with the required number of C406 additional energy efficiency and/or load management measure credits.
- Project design includes electric resistance or fossil fuel-fired equipment for primary space heating and/or service water heating.

When to Use the C407 Compliance Path

Means of claiming energy savings when…

- Building will be connected to a high-performance district energy system.
- Project includes heat recovery systems and/or ventilation energy recovery systems (other than Group R ventilation).
- Project includes unregulated energy saving strategies such as ENERGY STAR rated cooking & laundry appliances, high performance IT systems, refrigeration systems, etc.
- Project is pursuing LEED certification and thus a building energy model is already completed.

How Renewable Energy Applies

Incorporating C411 Renewable energy requirements

- Minimum required capacity for new buildings and additions larger than 10,000 SF is **0.5 watts per SF** of gross conditioned floor area.
- On-site and/or off-site renewable energy is applied to the site energy target. This minimum requirement is included in the site energy building performance factors (BPF)
- Can be applied to the site energy target to:
  - Offset deficiency via other better than code strategies if the project does not meet the minimum required on-site renewable energy capacity per one of the exceptions in C411.

Projects Pursuing LEED Certification

For projects pursuing LEED certification….

LEED program requirements allow use of an energy model per ASHRAE 90.1 Appendix G Performance Rating Method to achieve energy credit points:

- LEED version 4.0 based on ASHRAE 90.1-2010
- LEED version 4.1 based on ASHRAE 90.1-2016
- LEED version 5.0 based on ASHRAE 90.1-2019/2022

2021 WSEC-C based on ASHRAE 90.1-2019

Project Types That Can Use the C407 Compliance Path

- New construction
- Building additions
- Initial tenant improvements
- Spaces under-going a change of occupancy or space conditioning that require compliance with the current edition of the energy code
- Alterations where the whole building is modeled to demonstrate compliance (new construction and existing-to-remain combined)

C407 Compliance Documentation for Permit Review

- 2021 WSEC Webtool Smart Requirements Checklist(s) to document compliance with the mandatory provisions per Table C40.7
- 2021 WSEC Proposed and Target building UA calculations (target UA based on 2021 prescriptive insulation requirements)
- Envelope, mechanical, lighting and SWH design documents and any other information to verify that the design is consistent with the energy modeling analysis
- Completed ASHRAE Appendix G compliance forms for the 2021 WSEC-C
- Exceptional calculations for energy saving measures for unregulated loads

C407 Compliance Documentation for Phased Projects

Phased permit "conditional compliance" documentation

- Applies to shell & core projects and phased permit projects where building systems permit documentation will be submitted separately from architectural.
- Include "For reference only" documentation that provides all necessary design parameters to describe the basis of the baseline and proposed energy models.
- Include sufficiently complete reference level systems information for mechanical, service water, lighting, etc.
- For shell & core, include all baseline assumptions for yet-to-be-designed systems serving all future tenant spaces.
- Building official has the authority to accept conditional compliance documentation.

C407 Compliance Documentation for Permit Review

Statement of energy modeler qualifications

- ASHRAE Building Energy Modeling Professional (BEMP) certification
- Association of Energy Engineer's Building Energy Simulation Analyst (BESA) certification
- Successful completion of at least five projects modeled following any version of ANSI/ASHRAE/IESNA 90.1 Appendix G within the last three years that were reviewed and approved by a code official or rating authority.

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