



# CBES Public Hearing

## Changes from 2020 CBES to 2023 CBES

December 2, 2022  
10am – Noon



# Agenda

1. Meeting Logistics and Etiquette
2. Code Update Overview and Process
3. Proposed Updates to 2023 CBES
4. Public Comments



# Online Public Meeting Logistics

- ▶ Please remain muted with video off unless sharing comments.
  - We welcome participants to turn their video on while speaking.
- ▶ The Public Meetings are being recorded and will be posted on the PSD website after the event
- ▶ Participants are welcome to share their comments:
  - Please use the “raise your hand” function during discussion sections
  - If joining by phone, callers will be invited to press\*6 to unmute to share their comments. Press \*6 after comments to re-mute your phone.
  - Participants will be allotted 3 minutes to make sure everyone has an opportunity to share their comments. If there is time at the end of the meeting, there will be opportunities for additional and follow up comments.
    - Participants will be given a 1-minute warning and may be muted if they go over time

# Online Public Meetings Etiquette

To facilitate fair and respectful public hearings, the PSD asks participants to accept and abide by the following:

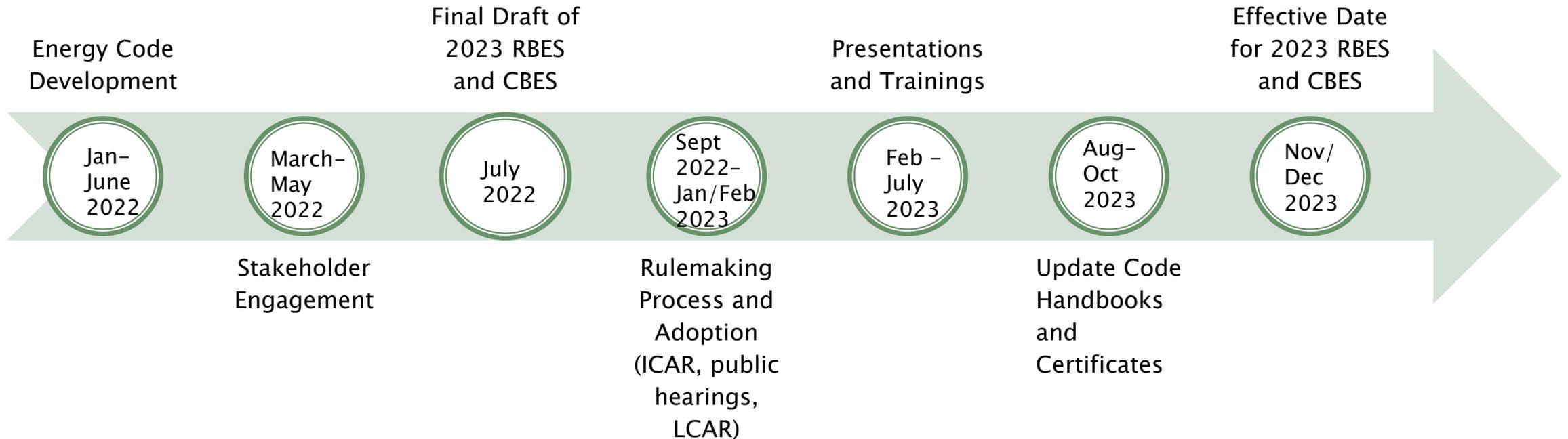
- ▶ Introduce yourself (and your organization, if appropriate)
- ▶ Be concise.
- ▶ Be respectful.
- ▶ Respect 3-minute time limit so that everyone has a chance to speak.
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- ▶ Spoken remarks can be supplemented by written comments.
- ▶ If known, state which part of the draft RBES or CBES the comments refer to.
- ▶ If there is time at the end of the meeting, there will be opportunities for follow up comments.

# Background on Vermont Commercial Building Energy Standards (CBES)

- ▶ Minimum standard of energy efficiency for new and renovated commercial buildings and residential buildings four stories or more
  - Initially passed by the Vermont legislature in May 2006
  - Updates in 2011, 2015, and 2020
- ▶ Updates are designed to provide reductions in energy use and emissions over the life of a building



# Timeline of 2023 Vermont Energy Code Update Process



# CBES is a Work in Progress

- ▶ Gathered recommendations
- ▶ Listened at Stakeholder and Advisory Committee meetings, to conversations and written comments
- ▶ Can submit written comments through Friday, December 9<sup>th</sup>
  - <https://publicservice.vermont.gov/content/energy-code-update-comments>
  - Or emailed to [psd.codeupdatecomm@vermont.gov](mailto:psd.codeupdatecomm@vermont.gov)



# Proposed Updates to 2023 CBES

# Energy Modeling

- ▶ Updated Building Performance Factors for those using the energy modeling compliance path.

**TABLE 4.2.1  
BUILDING PERFORMANCE FACTOR (BPF)**

BUILDING AREA TYPE	VERMONT BPF
Multifamily	0.60
Healthcare/hospital	0.52
Hotel/motel	0.44
Office	0.48
Restaurant	0.57
Retail	0.42
School	0.33
Warehouse	0.50
All Others	0.46

# Multifamily Alignment

- ▶ Aligned RBES and CBES standards for multifamily buildings to ensure that regardless of the building height, the base package energy standards, not including C406, would remain consistent.

Building Component	<4 Stories		4+ Stories
	In-Unit	Central System/ Common Area	
Mechanical	RBES	CBES	CBES
Water Heating			
Lighting & Power			
Envelope	RBES		
Points			
EV Ready			
Solar Ready			

# Section C406, Additional Efficiency, Renewable, and Load Management Package Options

- ▶ Complete rewrite of additional points requirement.
- ▶ Renamed Additional Efficiency, Renewable, and Load Management Requirements.
- ▶ Energy efficiency points required now depend on the building type.
  - Now have 31 efficiency measure options.
- ▶ Additional points requirement for renewable, load management, and embedded carbon.
  - Ten renewable, load management, and embedded carbon measure options.

# C406.1 Additional Energy Efficiency Credits

**TABLE C406.1.1**  
**Energy Credit Requirements by Building Occupancy Group**

	Building Occupancy Group								
	R-2, R-4, and I-1	I-2	R-1	B	A-2	M	E	S-1 and S-2	All Other
Energy Credit Requirements	79	46	83	30	60	75	90	65	36

**TABLE C406.1.2**  
**Renewable and Load Management Credit Requirements by Building Occupancy Group**

	Building Occupancy Group								
	R-2, R-4, and I-1	I-2	R-1	B	A-2	M	E	S-1 and S-2	All Other
Renewable and Load Management Credit Requirements	16	11	14	24	4	25	22	20	17

- ▶ \*Note that renewable and load management credit requirements have been reduced to **one-third** of PNNL CEPI-193 proposal

# C406.1 Additional Energy Efficiency Credits

**TABLE C406.2.1**  
Energy Credit Requirements by Building Occupancy Group <sup>a,b</sup>

ID	Energy Credit Measure	Building Occupancy Group								
		R-2, R-4, and I-1	I-2	R-1	B	A-2	M	E	S-1 and S-2	All Other
E01	Envelope Performance	Determined in accordance with Section C406.2.1.1								
E02	UA Reduction	19	5	13	20	33	28	25	37	28
E03	Envelope Leak Reduction	13	9	28	6	42	13	8	68	41
E04	Add Roof Insulation	7	2	3	3	2	24	23	10	9
E05	Add Wall Insulation	13	3	5	8	2	16	7	7	9
E06	Improve Fenestration	42	6	13	21	4	10	34	6	17
H01	HVAC Performance	18	x	x	x	x	32	x	x	x
H02	Heating Efficiency	14	11	6	9	19	29	15	44	18
H03	Cooling Efficiency	3	x	x	1	x	7	4	x	x
H04	Residential HVAC Control	21	x	x	x	x	x	x	x	x
H05	ERV	46	65	41	114	84	242	43	180	90
W01	SHW Preheat Recovery	93	6	36	12	34	13	13	3	26
W02	Heat Pump Water Heater	81	3	30	5	25	4	10	1	20
W04	SHW Pipe Insulation	6	1	4	4	2	4	4	1	3

**TABLE C406.2.1**  
Energy Credit Requirements by Building Occupancy Group <sup>a,b</sup>

ID	Energy Credit Measure	Building Occupancy Group								
		R-2, R-4, and I-1	I-2	R-1	B	A-2	M	E	S-1 and S-2	All Other
W05	Point of Use Water Heaters	x	x	x	18	x	x	4	x	11
W06	Thermostatic Balance Valves	3	0	2	1	1	1	1	1	1
W07	SHW Heat Trace System	11	1	7	5	3	5	5	2	5
W08	SHW Submeters	17	x	x	x	x	x	x	x	17
W09	SHW Distribution Sizing	68	x	26	x	x	x	x	x	47
W10	Shower Heat Recovery	25	1	9	x	x	x	3	x	10
P01	Energy Monitoring	3	3	2	3	2	5	3	5	3
L01	Lighting Performance	x	x	x	x	x	x	x	x	x
L02	Enhanced Digital Lighting Controls	1	4	1	4	1	5	4	3	3
L03	Increase Occupancy Sensors	1	4	2	4	1	6	3	4	3
L04	Increase Daylight Area	2	5	3	6	1	8	5	4	4
L05	Residential Light Control	3	x	x	x	x	x	x	x	x
L06	Reduced Lighting Power	1	5	1	5	1	6	5	4	4
Q01	Efficient Elevator Equipment	4	2	2	4	0	3	4	5	3
Q02	Commercial Kitchen Equipment	x	x	x	x	21	x	x	x	x
Q03	Residential Kitchen Equipment	13	x	10	x	x	x	x	x	x
Q04	Fault Detection	3	3	2	3	3	3	4	6	4

# C406.1 Additional Energy Efficiency Credits

**TABLE C406.1.2**

**Renewable and Load Management Credit Requirements by Building Occupancy Group**

ID	Renewable and Load Management Credit	Building Occupancy Group								
		R-2, R-4, and I-1	I-2	R-1	B	A-2	M	E	S-1 and S-2	All Other
R01	On-Site Renewable Energy	9	6	8	14	2	9	13	24	11
G01	Lighting Load Management	5	14	9	10	4	18	16	36	14
G02	HVAC Load Management	10	12	x	8	16	14	18	14	13
G03	Automated Shading	1	x	1	5	x	8	14	x	5
G04	Electric Energy Storage	14	13	13	16	4	11	20	24	14
G05	Cooling Energy Storage	7	11	12	12	2	9	16	1	9
G06	SHW Energy Storage	18	4	26	6	15	4	7	2	10
G07	Building Thermal Mass	27	26	26	8	6	13	31	20	20
C01	Insulation Embodied Carbon	5	3	4	8	1	8	7	6	5
E01	Additional Electric Infrastructure	16	x	x	x	x	x	x	x	x

# Building Insulation Requirements

TABLE C402.1(1) BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES AND ELEMENTS

COMPONENT	MAXIMUM OVERALL U-FACTOR		MINIMUM R-VALUES	
	2020 CBES	2023 CBES	2020 CBES	2023 CBES
Roofs				
Insulation entirely above deck	U-0.025	U-0.022	R-40ci	R-45ci
Metal buildings	U-0.026	U-0.023	R-25 + R-11 + R-11 LS	R-10 + R-10 + R-32ci
Attic and Other	U-0.021	U-0.017 (0.020 for R2)	R-49	R-60 (R-49 for R2)
Walls, Above grade				
Mass	U-0.048	U-0.037	R-19ci	R-25ci
Metal Building	U-0.044	U-0.039	R-13 + R-17ci or R-22.1ci	R-13 + R-19.5ci or R-25ci
Metal-framed	U-0.044	U-0.037	R-13 + R-15ci or R-20ci	R-13 + R-18.8ci or R-25ci
Wood-framed and other	U-0.042	U-0.036 (0.033 for R2)	R-13 + R-12ci or R-19 + R-8ci or R-20ci	R-13 + R-18.8ci or R-19 + R-15ci or R-25ci

# Building Insulation Requirements

TABLE C402.1(1) BUILDING ENVELOPE REQUIREMENTS—OPAQUE ASSEMBLIES AND ELEMENTS

COMPONENT	MAXIMUM OVERALL U-FACTOR		MINIMUM R-VALUES	
	2020 CBES	2023 CBES	2020 CBES	2023 CBES
Walls, Below Grade				
Below-grade Wall	U-0.063	U-0.048	R-15ci	R-20ci
Floors				
Mass	U-0.051	U-0.038	R-16.7ci	R-23ci
Joist/Framing-Metal	U-0.032	U-0.027	R-38	R-38 + R-6ci
Joist/Framing-Wood and Other	U-0.033	U-0.027	R-30	R-38
Slab-on-Grade Floors				
Unheated Slab	F-0.360	F-0.434	R-10 for entire slab	R-20 for 48" below
Heated Slab	F-0.373	F-0.433	R-20 for entire slab	R-20 for 48" below + R-15 full slab

# Building Fenestration Requirements

TABLE C402.3  
BUILDING ENVELOPE FENESTRATION MAXIMUM  
U-FACTOR AND SHGC REQUIREMENTS

- Added a separate requirement for storefront fenestration.
- Improved window U-value requirements.

VERTICAL FENESTRATION				
	2020 CBES		2023 CBES	
U-factor				
Fixed Fenestration	0.33		0.29 (0.33 for storefront)	
Operable fenestration	0.37		0.36 (0.27 for R2)	
Entrance doors	0.68		0.63	
SHGC				
Orientation or Operation	SEW	N	Fixed	Operable
PF < 0.2	0.40	0.37	0.38	0.34
0.2 ≤ PF < 0.5	0.48	0.58	0.46	0.41
PF ≥ 0.5	0.64	0.64	0.61	0.54
SKYLIGHTS				
U-factor	0.48		0.41	
SHGC	0.38		0.38	

# Air Leakage Requirements

- ▶ Removed air barrier compliance path through air barrier commissioning unless over 250,000 SF or where blower door tests are unfeasible; must now do blower door and not exceed a maximum CFM/SF
- ▶ After failing a blower door test and taking corrective actions, you now must pass the original air barrier performance requirement as opposed to the relaxed requirement that existed in 2020 CBES.
- ▶ Air leakage requirement improved from 0.30 CFM/SF to 0.25 CFM/SF at 75 Pa.
- ▶ Added exception for R-2 buildings six stories or less to be 0.15 CFM/SF at 50 Pa.
- ▶ Rewrote requirement on which dwelling and sleeping units need to be individually blower door tested.

# Solar Ready Zone

## **C402.5.1 General.**

A solar-ready zone shall be located on the roof of buildings that are five stories or less in height above grade plane, and are oriented between 110 degrees and 270 degrees of true north or have low-slope roofs. Solar-ready zones shall comply with Sections C402.5.2 through C402.5.8.

## **C402.5.2 Construction document requirements for a solar-ready zone.**

Construction documents shall indicate the solar-ready zone.

## **C402.5.3 Solar-ready zone area.**

The total solar-ready zone area shall be not less than 40 percent of the roof ...

## **C402.5.5 Roof loads and documentation.**

A collateral dead load of not less than 5 pounds per square foot (5 psf) (24.41 kg/m<sup>2</sup>) shall be included in the gravity and lateral design calculations for the solar-ready zone. The structural design loads for roof dead load and roof live load shall be indicated on the construction documents.

# IECC Updated Mechanical Equipment Efficiency Requirements

- ▶ Efficiency requirements have been updated for most existing tables within section C403.3.2 – HVAC Equipment Performance Requirements. Updates include but are not limited to:
  - SEER requirements after 1/1/2023 for electrically operated unitary ACs/Heat Pumps
  - Adjustments to warm-air furnace thermal efficiency requirements
- ▶ Several new tables have been added providing additional specificity. Added tables include:
  - Vapor-compressor indoor pool dehumidifier efficiency requirements under table C403.3.2(11).
  - Direct expansion dedicated outdoor air system (DX DOAS) efficiency requirements under tables C403.3.2(12) and C403.3.2(13).
  - Ceiling-mounted computer-room air conditioner efficiency requirements under table C403.3.2(16)

# Commercial Refrigerators and Freezers

- ▶ Refrigeration equipment performance has been revised
- ▶ The previous minimum efficiency requirement tables C403.10.1(1) and C403.10.1(2) have been consolidated into a single table.

# Fault Detection and Diagnostics

**New addition, matching IECC 2021:**

**C403.2.3 Fault detection and diagnostics** . New buildings with an HVAC system serving a gross conditioned floor area of 100,000 square feet (9290 m<sup>2</sup>) or larger shall include a fault detection and diagnostics (FDD) system to monitor the HVAC system's performance and automatically identify faults. The FDD system shall:

1. Include permanently installed sensors and devices to monitor the HVAC system's performance.
2. Sample the HVAC system's performance at least once every 15 minutes.
3. Automatically identify and report HVAC system faults.
4. Automatically notify authorized personnel of identified HVAC system faults.
5. Automatically provide prioritized recommendations for repair of identified faults based on analysis of data collected from the sampling of HVAC system performance.
6. Be capable of transmitting the prioritized fault repair recommendations to remotely located authorized personnel.

▶ **Exception:** R-1 and R-2 occupancies.

▶

# Ventilation

- ▶ Revisions to C403.7.1 Demand Control Ventilation requirements and exceptions
  - Exception 3: spaces where more than 75% of the space design outdoor airflow is required for makeup air that is exhaust from the space or transfer air that is required for makeup air that is exhaust from other spaces.

This is an adjustment to the existing exception, which was for spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement was less than 1,200 CFM.



# Proper Heat Pump Sizing

## Added heat pump language:

### ▶ **C403.3.1 Equipment sizing**

The output capacity of heating and cooling equipment shall be not greater than that of the smallest available equipment size that exceeds the loads calculated in accordance with Section C403.1.1. A single piece of equipment providing both heating and cooling shall satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options. Heating and cooling equipment sizing is permitted to be up to 10 percent greater (to the next nearest available size) than the calculated peak heating and cooling loads to allow for building pickup and cool down after temperature setback conditions. **Heat pump equipment shall not be sized greater than the calculated peak heating and cooling loads, as they are exempt from temperature setbacks and are significantly less efficient when oversized. Outdoor condensing units serving multiple indoor heat pump units shall be sized equal or less than the total capacity of the indoor units.**

# Duct and Plenum Insulation

Removed verbiage to provide clarity that ALL ductwork outside of the building should be insulated to R-12.

Added IECC 2021 language for underground ductwork.

▶ **C403.12.1 Duct and plenum insulation and sealing.**

~~Supply and return~~ Air ducts and plenums shall be insulated with not less than R-8 insulation where located in unconditioned spaces and where located outside the building with not less than R-12 insulation. **Ducts located underground beneath buildings shall be insulated as required in this section or have an equivalent thermal distribution efficiency. Underground ducts utilizing the thermal distribution efficiency method shall be listed and labeled to indicate the R-value equivalency.** Where located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by not less than R-12 insulation. Buried ducts shall be insulated to a minimum of R-6.

# New Low-Capacity Ventilation Fans

**C403.8.5 Low-capacity ventilation fans.** Mechanical ventilation system fans with motors less than 1/12 hp (0.062 kW) in capacity shall meet the efficacy requirements of Table C403.8.5 at one or more rating points.

**Exceptions:**

1. Where ventilation fans are a component of a listed heating or cooling appliance.
2. Dryer exhaust duct power ventilators, domestic range hoods, and domestic range booster fans that operate intermittently.

**TABLE C403.8.5 LOW-CAPACITY VENTILATION FAN EFFICACY<sup>a</sup>**

FAN LOCATION	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIRFLOW RATE MAXIMUM (CFM)
HRV or ERV	Any	1.2 cfm/watt	Any
In-line fan	Any	3.8 cfm/watt	Any
Bathroom, utility room	10	2.8 cfm/watt	<90
Bathroom, utility room	90	3.5 cfm/watt	Any

SI: 1 cfm/ft = 47.82 W.

a. Airflow shall be tested in accordance with HVI 916 and listed. Efficacy shall be listed or shall be derived from listed power and airflow. Fan efficacy for fully ducted HRV, ERV, balanced and in-line fans shall be determined at a static pressure not less than 0.2 inch w.c. Fan efficacy for ducted range hoods, bathroom and utility room fans shall be determined at a static pressure not less than 0.1 inch w.c.

# Allowance for Electric Boilers

Electric boilers shall be allowed under certain conditions, i.e. supplemental heat for buildings with PV and thermal storage and as supplemental heat for GSHP and WSHP.



# Lighting for Dwelling and Sleeping Units

**Lighting for dwelling and sleeping units.** All permanently installed lighting serving dwelling units and sleeping units, excluding kitchen appliance lighting, shall contain only high-efficacy lighting. Lamps with an efficacy of not less than 65 lm/W or luminaires with an efficacy of not less than 55 lm/W. Non-multifamily building may alternatively comply with Sections C405.2.4 and C405.3.



# Lighting Power Density

TABLE C405.3.2(1)  
 INTERIOR LIGHTING POWER ALLOWANCES:  
 BUILDING AREA METHOD

- ▶ Lighting power density improved, approximately 15% more efficient but varies by building area type or space-by-space type.

BUILDING AREA TYPE LPD (W/ft <sup>2</sup> )	2020 CBES	2023 CBES
Dining: family	0.69	0.58
Dormitory	0.47	0.41
Health care clinic	0.69	0.62
Hotel/Motel	0.56	0.50
Library	0.78	0.66
Manufacturing facility	0.82	0.68
Multifamily	0.45	0.38
Office	0.64	0.53
Parking garage	0.14	0.13
Religious building	0.67	0.60
Retail	0.84	0.73
School/university	0.67	0.57
Sports arena	0.71	0.61
Town hall	0.67	0.56
Warehouse	0.43	0.36
Workshop	0.83	0.72

# Automatic Receptacle Controls

- The following shall have automatic receptacle control complying with Section C405.11.1:
  1. At least 50 percent of all 125V, 15- and 20-amp receptacles installed in enclosed offices, conference rooms, rooms used primarily for copy or print functions, breakrooms, classrooms, and individual workstations, including those installed in modular partitions and module office workstation systems.
  2. At least 25% of branch circuit feeders installed for modular furniture not shown on the construction documents.



# Energy Monitoring

- ▶ New buildings with a gross conditioned floor area of 25,000 square feet (2322 m<sup>2</sup>) or larger shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.12.1 through C405.12.5.
  - Expand energy monitoring requirement to include EV chargers?
  - Consider reducing floor area to 10,000 square feet?

## Exception:

- ▶ R-2 occupancies and individual tenant spaces are not required to comply with this section provided that the space has its own utility services and meters and has less than 5,000 square feet (464.5 m<sup>2</sup>) of conditioned floor area.

# Electric Vehicle Charging Parking Spaces

- ▶ All required charging station must be Level 2 chargers or better.
- ▶ Revised requirement for charging stations and future ready/capable spaces.

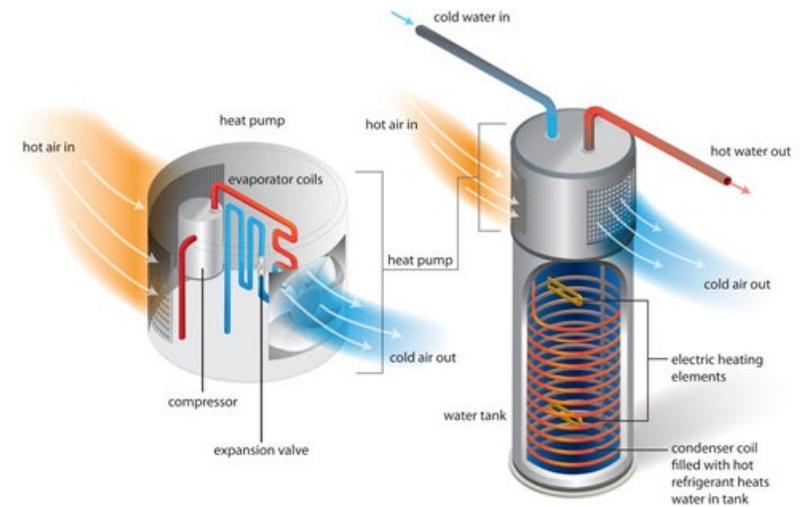
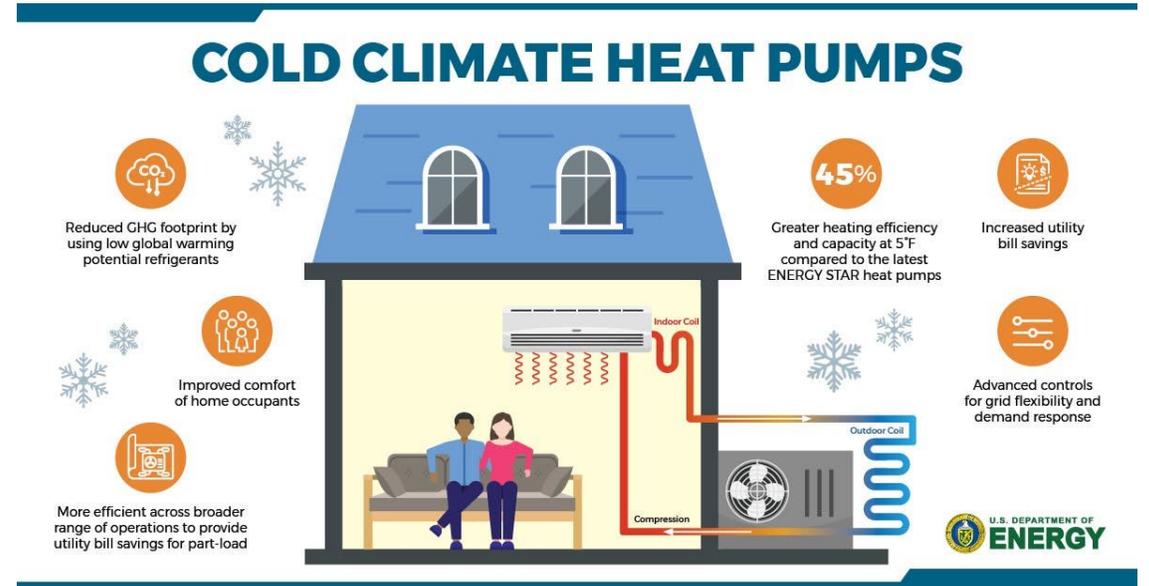
COMMERCIAL BUILDING OCCUPANCY <sup>a</sup>	EVSE SPACES	EV READY SPACES	EV CAPABLE SPACES
Groups A, M	2%	0%	20%
Group B	6%	0%	30%
Group E	4%	0%	20%
Groups F, H, S	2%	0%	10%
Groups I, R-3, R-4	3%	0%	10%
Group R-1	8%	7%	50%
Group R-2	0%	0%	Determined in Equation 4-11

*Equation 4-11*

$$R2EVC = D/SU + 0.25 * (APS - D/SU)$$

# Electric Ready

- ▶ Electric readiness for future electric space heating, electric water heating, electric cooking equipment, and electric dryers.
- ▶ Exception for R-2 buildings, but R-2 buildings may get points in Section C406 for including electric ready systems.



# Other Proposed Changes Described in the Appendix

- ▶ Changes to the CBES certificate
- ▶ More details on PNNL CEPI-193, the basis for C406 in CBES
- ▶ Automatic HVAC interlocking with large door operation
- ▶ Parking garage lighting control
- ▶ Escalator energy recovery
- ▶ More details on automatic receptacle control

# Other Proposed Changes Described in the Appendix

- ▶ Data Centers changes to ASHRAE 90.4
- ▶ HVAC Automatic Start/Stop in unoccupied hours with exemption for heat pumps
- ▶ Enclosed parking garage ventilation controls
- ▶ Fan Efficiency = Fan Energy Index
- ▶ Guest Room Temperature Setpoint Control
- ▶ Whole Building Water Heater Efficiency
- ▶ DHW Circulation Controls – IECC Language NOT Incorporated



# Public Comments

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# Submit Written Public Comments

- ▶ Can submit written comments through Friday, December 9<sup>th</sup>
  - <https://publicservice.vermont.gov/content/energy-code-update-comments>
  - Or emailed to [psd.codeupdatecomm@vermont.gov](mailto:psd.codeupdatecomm@vermont.gov)

# Appendix A

- ▶ Additional Changes to CBES 2023

# CBES Certificate

- ▶ CBES Certificate and Affidavits will now also include thermal envelope details and an indication of the solar-ready zone.
- ▶ The certificate shall include the following:
  1. Compliance method.
  2. Thermal envelope details including:
    1. R-values of insulation installed in or on ceilings, roofs, walls, foundations and slabs, 101229848 basement walls, crawl space walls and floors and ducts outside conditioned spaces.
    2. U-factors and solar heat gain coefficients (SHGC) of fenestrations.
  3. Results from any building envelope air leakage testing performed on the building.
  4. An indication of the solar-ready zone and other requirement of Section C402.5.

# PNNL's CEPI-193: Their Proposal to the 2024 IECC

- ▶ Credits based on PNNL's CEPI-193 proposal for updates to IECC 2024
  - Energy savings roughly 0.1% energy savings per point as opposed to 2021 IECC where it is 0.25%
  - Points and credit language has been adjusted to reflect CBES 2020 and 2023 proposals
  - Additional measures – 31 total
- ▶ Base package of cost-effective measures achieves an average of 9.4% energy cost savings
  - Individually none of these credits are required..
  - Available points far exceed required points – giving lots of flexibility.

# Operable Openings Interlocking

Where occupancies utilize operable openings to the outdoors that are larger than 40 square feet (3.7 m<sup>2</sup>) in area, such openings shall be interlocked with the heating and cooling system so as to raise the cooling setpoint to 90° F (32° C) and lower the heating setpoint to 55° F (13° C) whenever the operable opening is open. The change in heating and cooling setpoints shall occur within 10 minutes of opening the operable opening.

## Exceptions:

1. Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.
2. Warehouses that utilize overhead doors for the function of the occupancy, where approved by the code official.
3. The first entrance doors where located in the exterior wall and are part of a vestibule system.

# Mechanical Systems



# Data Center Exemption

- ▶ **C403.1 General.**

In addition to the mechanical requirements of Section C403, mechanical enhancements may be needed to meet the requirements of Section C406, Additional Efficiency Package Options. See Section C406.

- ▶ Mechanical systems and equipment serving the building heating, cooling, ventilating or refrigerating needs shall comply with this section.

- ▶ **Exception: Data center systems are exempt from the requirements of Sections C403.4 and C403.5.**

- Section C403.4 = HVAC system controls
- Section C403.5 = Economizers

# Data Center Addition

**C403.1.2 Data centers.** Data center systems shall comply with Sections 6 and 8 of **ASHRAE 90.4** with the following changes:

1. Replace maximum design mechanical load component (MLC) values specified in Table 6.2.1.1 of the ASHRAE 90.4 with the value in Table C403.1.2(1).
2. Replace maximum annualized MLC values specified in Table 6.2.1.2 of the ASHRAE 90.4 with the value in Table C403.1.2(2).

**TABLE C403.1.2(1)**  
**MAXIMUM DESIGN MECHANICAL LOAD COMPONENT (DESIGN MLC)**

DESIGN MLC AT 100% AND AT 50% ITE LOAD
0.22

**TABLE C403.1.2(2)**  
**MAXIMUM ANNUALIZED MECHANICAL LOAD COMPONENT (ANNUALIZED MLC)**

HVAC MAXIMUM ANNUALIZED MLC AT 100% AND AT 50% ITE LOAD
0.17

# HVAC Automatic Start/Stop

- ▶ **C403.4.2.3 Automatic start and stop**

Automatic start controls shall be provided for each HVAC system. The automatic start controls shall be configured to automatically adjust the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy. Automatic stop controls shall be provided for each HVAC system with direct digital control of individual zones. **The automatic stop controls shall be configured to reduce the HVAC system's heating temperature setpoint and increase the cooling temperature setpoint by not less than 2° F (0.555°C) before scheduled unoccupied periods based on the thermal lag and acceptable drift in space temperature that is within comfort limits.**

- ▶ **Exemption: Cold climate heat pump systems**

- (this is an exemption added specifically for Vermont CBES, not in IECC)

# Enclosed Parking Garage Ventilation Controls

- ▶ **C403.7.2 Enclosed parking garage ventilation controls.**

Enclosed parking garages used for storing or handling automobiles operating under their own power shall employ ~~contamination sensing devices~~ **carbon monoxide detectors applied in conjunction with nitrogen dioxide detectors** and automatic controls configured to stage fans or modulate fan average airflow rates as stipulated in the Vermont Fire and Building Safety Code enforced by the Vermont Department of Public Safety's Division of Fire Safety. Failure of contamination-sensing devices shall cause the exhaust fans to operate continuously at design airflow .

- ▶ **Exceptions:**

- ▶ 1. Garages with a total exhaust capacity less than 4,000 cfm (1,888 L/s) with ventilation systems that do not utilize heating or mechanical cooling.
- ▶ 2. Garages that have a garage area to ventilation system motor nameplate power ratio that exceeds 1,125 cfm/hp (710 L/s/kW) and do not utilize heating or mechanical cooling.

- ▶

# Energy Recovery Requirement

Clarify table and when ERVs are required:

▶ **C403.7.4 Spaces other than nontransient dwelling units.**

Where the supply airflow rate of a fan system serving a space other than a nontransient dwelling unit exceeds the values specified in Table C403.7.4, the system shall include an energy recovery system. The energy recovery system shall provide an enthalpy recovery ratio of not less than 50 percent at design conditions. Where an air economizer is required, the energy recovery system shall include a bypass or controls that permit operation of the economizer as required by Section C403.5.

▶

▶ **Exception:** An energy recovery ventilation system shall not be required in any of the following conditions:

- ▶ 1. Where energy recovery systems are prohibited by ASHRAE Standard 62.1.
- ▶ 2. Laboratory fume hood systems that include not fewer than one of the following features:
  - ▶ 2.1. Variable-air-volume hood exhaust and room supply systems configured to reduce exhaust and makeup air volume to 50 percent or less of design values.
  - ▶ 2.2. Direct makeup (auxiliary) air supply equal to or greater than 75 percent of the exhaust rate, heated not warmer than 2° F (1.1° C) above room setpoint, cooled to not cooler than 3° F (1.7° C) below room setpoint, with no humidification added, and no simultaneous heating and cooling used for dehumidification control.
- ▶ 3. Systems serving spaces that are heated to less than 60° F (15.5° C) and that are not cooled.
- ▶ 4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site-solar energy.
- ▶ 5. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
- ▶ 6. Systems expected to operate less than 20 hours per week at the *outdoor air* percentage covered by Table C403.7.4.
- ▶ 7. Systems exhausting toxic, flammable, paint or corrosive fumes or dust.
- ▶ 8. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

**TABLE C403.7.4 ENERGY RECOVERY REQUIREMENT**  
 (Air Ventilation systems operating not less than 3,000 hours per year)

PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE							
≥ 10% and <20%	≥ 20% and <30%	≥ 30% and <40%	≥ 40% and <50%	≥ 50% and <60%	≥ 60% and <70%	≥ 70% and <80%	≥ 80%
Design Supply Fan Airflow Rate (cfm)							
≥ 10,500	≥ 6,500	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 120

# Fan Efficiency = Fan Energy Index

Fan efficiency rating determined by fan energy index rather than fan efficiency grade (FEG):

- ▶ **C403.8.3 Fan efficiency.**

Each fan and fan array shall have a **fan energy index (FEI) of not less than 1.00 at the design point of operation**, as determined in accordance with AMCA 208 by an *approved*, independent testing laboratory and labeled by the manufacturer. Each fan and fan array used for a variable-air-volume system shall have an **FEI of not less than 0.95 at the design point of operation** as determined in accordance with the AMCA 208 by an approved independent testing laboratory and labeled by the manufacturer. The FEI for fan arrays shall be calculated in accordance with AMCA 208 Annex C.

- ▶

# IECC Temperature Setpoint Controls (Guest Rooms)

- ▶ C403.7.6.1 – Guest room HVAC systems are to be capable of and configured with three modes of temperature control.

These are specific to:

- When the room is rented but unoccupied
- When the room is unrented and unoccupied
- When the room is occupied

# Whole Building Water Heater Efficiency

- ▶ **C404.2.1 High input service water-heating systems.**

Gas-fired water-heating equipment installed in new buildings shall be in compliance with this section. Where a singular piece of water-heating equipment serves the entire building, such equipment shall have a thermal efficiency,  $E_t$ , of not less than ~~92~~ 95 percent. Where multiple pieces of water-heating equipment serve the building and the combined input rating of the water-heating equipment is 1,000,000 Btu/h (293 kW) or greater, the combined input-capacity-weighted-average thermal efficiency,  $E_t$ , shall be not less than ~~92~~ 95 percent.

- ▶ **Exceptions:**

- ▶ 1. Where not less than 25 percent of the annual *service water-heating* requirement is provided by *on-site renewable energy* or site-recovered energy, the minimum thermal efficiency requirements of this section shall not apply.
- ▶ 2. The input rating of water heaters installed in individual dwelling units shall not be required to be included in the total input rating of *service water-heating* equipment for a building.
- ▶ 3. The input rating of water heaters with an input rating of not greater than 100,000 Btu/h (29.3 kW) shall not be required to be included in the total input rating of *service water-heating* equipment for a building.

# Service Water Heating – IECC Language NOT Incorporated

## ▶ **C404.6.1 Circulation systems.**

Heated-water circulation systems shall be provided with a circulation pump. The system return pipe shall be a dedicated return pipe or a cold water supply pipe. Gravity and thermo-syphon circulation systems shall be prohibited. **Controls for circulating hot water system pumps shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is not a demand for hot water. The controls shall limit the temperature of the water entering the cold water piping to not greater than 104° F (40° C).**

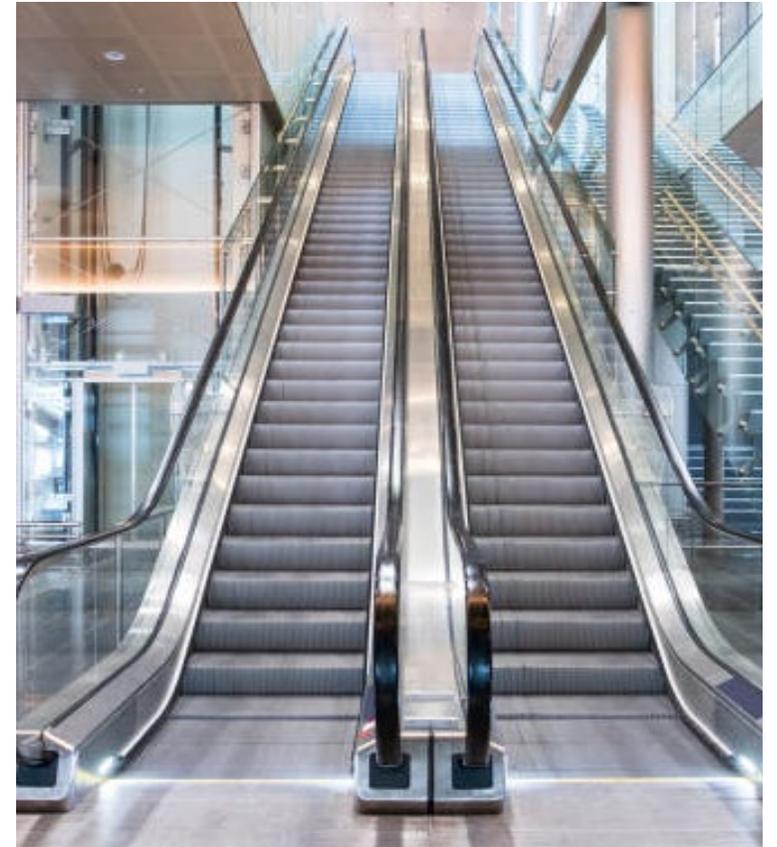
# Parking Garage Lighting Control

- Parking garage lighting shall be controlled by an occupant sensor complying with Section C405.2.1.1 or a *time-switch control* complying with Section C405.2.2.1. Additional lighting controls shall be provided as follows:
  1. Lighting power of each luminaire shall be automatically reduced by not less than 30 percent when there is no activity detected within a lighting zone for 20 minutes. Lighting zones for this requirement shall be not larger than 3,600 square feet (334.5 m<sup>2</sup>).

**Exception:** Lighting zones provided with less than 1.5 footcandles of illumination on the floor at the darkest point with all lights on are not required to have automatic light-reduction controls.
  2. Where lighting for eye adaptation is provided at covered vehicle entrances and exits from buildings and parking structures, such lighting shall be separately controlled by a device that automatically reduces lighting power by at least 50 percent from sunset to sunrise.
  3. The power to luminaires within 20 feet (6096 mm) of perimeter wall openings shall automatically reduce in response to daylight by at least 50 percent.

# Escalator Energy Recovery

Escalators shall be designed to recover electrical energy when resisting overspeed in the down direction. The escalator shall be designed to recover, on average, more power than is consumed by the power recovery feature of its motor controller system.



# Automatic Receptacle Controls

## ▶ Automatic receptacle controls shall comply with the following:

1. Either split controlled receptacles shall be provided with the top receptacle controlled, or a controlled receptacle shall be located within 12 inches (304.8 mm) of each uncontrolled receptacle.

2. One of the following methods shall be used to provide control:

A scheduled basis using a time-of-day operated control device that turns receptacle power off at specific programmed times and can be programmed separately for each day of the week. The control device shall be configured to provide an independent schedule for each portion of the building of not more than 5,000 square feet (464.5 m<sup>2</sup>) and not more than one floor. The occupant shall be able to manually override an area for not more than 2 hours. Any individual override switch shall control the receptacles of not more than 5,000 feet (1524 m).

2.2. An occupant sensor control that shall turn off receptacles within 20 minutes of all occupants leaving a space.

2.3. An automated signal from another control or alarm system that shall turn off receptacles within 20 minutes after determining that the area is unoccupied.

3. All controlled receptacles shall be permanently marked in accordance with NFPA 70 and be uniformly distributed throughout the space.

4. Plug-in devices shall not comply.