

2015 VERMONT COMMERCIAL BUILDING ENERGY STANDARDS (CBES)

MARCH 10, 2015

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For more information

http://publicservice.vermont.gov/topics/energy_efficiency/code_update





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2015 Vermont Commercial Building Energy Standards

Course Number: 000441

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Course Description

This 3 hour workshop on the 2015 Vermont Commercial Building Energy Standards (CBES, aka “the energy code”) is intended for architects, engineers, consultants, and contractors and all other design and construction professionals.

The intent of the workshop is to provide attendees with the information needed to understand and comply with the code, and, in particular, understand the changes in this 2015 code update from the previous 2011 version.

The workshop briefly covers the origin of the code, describes which buildings and renovation projects are covered, explains the compliance paths available, and covers the certification requirements.

Opportunities for exceeding code requirements for achieving greater building efficiencies than required are also presented.



Learning Objectives

At the end of the this course, participants will be able to:

- 1. Understand major changes to VT's commercial energy code, effective 3/1/2015**
- 2. Understand impacts of updated code on commercial building projects**
- 3. Be able to follow code requirements for certifying compliance**
- 4. Learn about opportunities for seeking support to meet and exceed code requirements**



Agenda

- ▶ **Energy Codes Update Background/Overview**
- ▶ **Commercial Energy Code Update**
 - **Scope / Application / Administration**
 - **Building Envelope**
 - **Mechanical**
 - **Service Water Heating**
 - **Lighting**
 - **Commissioning**
 - **Existing Buildings**
- ▶ **Efficiency VT's New Construction Program**
- ▶ **Q & A**

Update Team

- ▶ Kelly Launder and Barry Murphy, *Vermont Public Service Department*
- ▶ Stu Slote and Keith Downes, *Navigant*
- ▶ Tim Guiterman, *EnergySavvy*
- ▶ Richard Faesy and Jim Grevatt, *Energy Futures Group*
- ▶ Jim Edelson, *New Buildings Institute*
- ▶ Eric Makela, *Britt Makela Group*
- ▶ Mike DeWein, *Consultant*

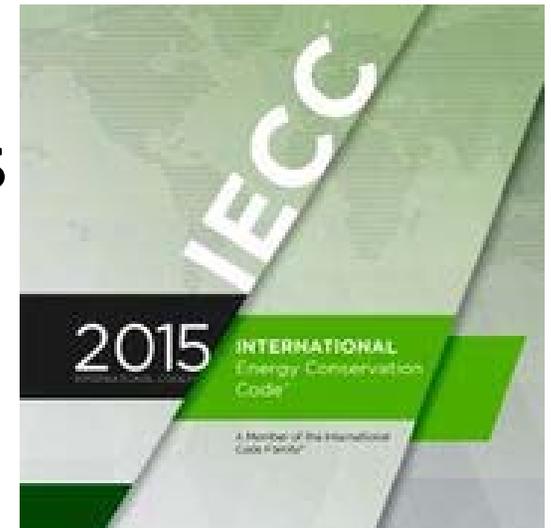
Background

- ▶ **Energy code update required by Vermont Law**
 - Every 3 years
- ▶ **Also adopted stretch code to apply to residential Act 250 projects (per Act 89)**
- ▶ **Adopted via state rulemaking process**
- ▶ **Managed by Public Service Department**

Foundational Document

2015 International Energy Conservation Code (IECC)

- ▶ Effectively similar to 2012 IECC, but still changed compared with 2011 CBES
- ▶ Better clarifications and definitions
- ▶ Chapter on Existing Buildings
- ▶ Commercial chapter references
ASHRAE / IESNA Standard 90.1–2013



Effective Dates

▶ Commercial (CBES)

- Base Code – March 1, 2015
- Stretch Guideline – under development

▶ Residential (RBES)

- Base Code – March 1, 2015
 - Must use 2015 RBES if construction on/after March 1, 2015 – shovel/backhoe in ground
- Stretch Code – December 1, 2015
 - Act 250 projects

Which CBES Version to Use?

Permit Application / Commenced Construction

- ▶ Before Dec 1, 2014
 - Can use 2011 CBES until Dec 1, 2014 and commenced construction by Sept 1, 2015

- ▶ between Dec 1, 2014 and March 1, 2015
 - Can use either 2011 CBES or 2015 CBES and commenced construction by Sept 1, 2015

- ▶ After March 1, 2015
 - Must use 2015 CBES

Update Timeline

- ▶ **Stakeholder Meetings**
 - February 2014 Webinars
 - March & June Stakeholder Meetings–Pittsford, Burlington, Windsor
- ▶ **Initial Comment Period Ended – early July 2014**
- ▶ **Draft filed with ICAR – end of July**
- ▶ **Revised draft – August 19; filed with Secretary of State**
- ▶ **Public Hearing – September 19**
- ▶ **Public Comment Period ended – September 26**
- ▶ **LCAR Hearing – October 30**
- ▶ **Adoption Date – December 1, 2014**
- ▶ **Effective Date – March 1, 2015**

Commercial Building Energy Standards (CBES) Update

Acknowledgements

- ▶ Lots of stakeholder input
- ▶ PSD online resources
 - http://publicservice.vermont.gov/topics/energy_efficiency/code_update
- ▶ A great deal of material borrowed from US DOE's Building Energy Codes Program
 - <http://www.energycodes.gov/resource-center/training-courses/commercial-envelope-requirements-2015-iecc>

Why Care About CBES?

- ▶ Energy codes and standards set minimum efficiency requirements for new and renovated buildings, assuring reductions in energy use and emissions over the life of the building
- ▶ Energy codes are a subset of building codes, which establish baseline requirements and govern building construction
 - Code buildings are more comfortable and cost-effective to operate, assuring energy, economic and environmental benefits



Structure of the 2015 CBES

- Ch. 1 Scope and Administration
- Ch. 2 Definitions
- Ch. 3 General Requirements
- Ch. 4 Commercial Energy Efficiency
- Ch. 5 Existing Buildings – **NEW**
- Ch. 6 Referenced Standards

Does My Project Need to Comply with 2015 CBES?



All buildings other than R-2, R-3, R-4, three stories or less in height

- R-2: permanent occupancy with more than 2 dwelling units – apartments, boarding houses, dormitories, etc. (not hotel/motel)
- R-3: one- and two-family dwellings
- R-4: residential care and assisted living facilities



Scope: *Section C101.2* Scope

- ▶ Language taken from ASHRAE 90.1–2013
 - ▶ CBES applies to:
 1. New buildings and their systems
 2. New portions of buildings and their systems
 3. New systems and equipment in existing buildings
 4. ** New equipment or building systems specifically identified in the standard that are part of industrial or manufacturing processes **
- ** Prior CBES language confused users and was mistakenly interpreted as exemption for industrial buildings
(Note: *Farm Structures* exempted per statute)

Scope: *Section C101.4.1* Mixed Occupancy & *C101.5* Compliance

- ▶ If mixed use and 3 stories or less
 - “Residential Building” includes living/nonliving spaces that serve *residential uses only*
 - “Commercial Building” includes *commercial uses* within structure and *all* common areas/facilities that serve *both residential and commercial uses*
- ▶ If 4 stories or more
 - “Commercial Building” includes *all uses and areas within*
- ▶ Commercial Buildings shall meet CBES
- ▶ Residential Buildings shall meet RBES

Exempt Buildings: *Section C101.5.2*

Buildings or portions of buildings separated from remainder of building by thermal envelope assemblies meeting code requirements are exempt from Envelope provisions if:

- Low energy buildings: Peak design rate of energy < 1.0 watt/ft² of floor area for space conditioning purposes, OR
- Those portions or building that do not contain conditioned space, OR
- Greenhouses, OR
- Inflatable buildings: Above-ground, when built for temporary purposes, OR
- Equipment buildings: < 500 ft² and > 7 watts/ft² of electronic equipment, etc.

Commercial Compliance Options

1 2015 CBES – Prescriptive

OR

2 ASHRAE 90.1-2013

- C402 – Envelope
- C403 – Mechanical
- C404 – Service Water Heating
- C405 – Lighting

AND

- Pick One - C406

C406.2 – Eff. HVAC Performance

C406.5 – On-site Supply of Renewable energy

OR

OR

C406.3 – Reduced Lighting Power Density

C406.6 – Dedicated Outdoor Air System

OR

OR

C406.4 – Enhanced Lighting Controls

C406.7 – High Eff. Service Water Heating

OR

Additional Efficiency Packages: *Section C406*

Projects must choose one of six packages

1. Efficient HVAC (10% improvement)
2. Efficient lighting (90% of stated LPD values)
3. Enhanced digital lighting controls
4. On-site renewables (≥ 0.50 watts per ft² of conditioned floor area OR $\geq 3\%$ of energy used for mechanical and service water heating equipment and lighting)
5. Dedicated outdoor air system with energy recovery and supply-air temperature reset
6. Reduced energy use in service water heating
 1. Only for Groups R-1, I-2, A-2, F, R-2, A-3 or high load

Code Changes C402 Building Envelope

Summary of Major Changes: Building Envelope

- ▶ R-Values / U-factors aligned with 2015 IECC (unless 2011 CBES was more stringent)
- ▶ Maximum window area reduced from 40% to 30% (exception allowed if using daylighting controls)
- ▶ Maximum skylight area maintained at 3%, but 5% allowed if using daylighting controls)
- ▶ Window SHGC requirements change with orientation
- ▶ Skylights required for high-bay space $> 2,500 \text{ ft}^2$

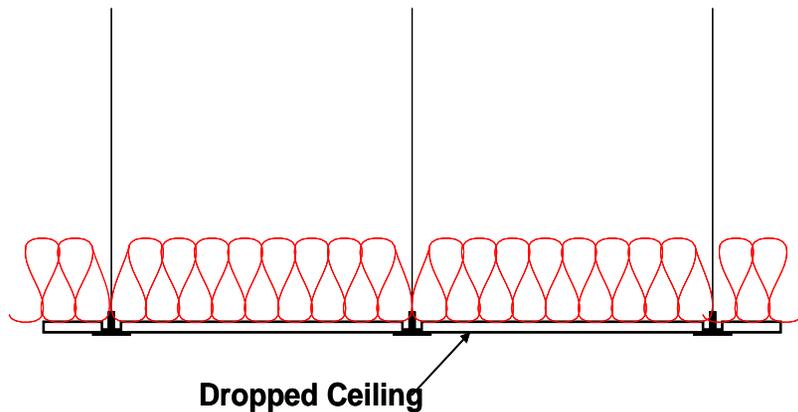
Building Envelope: Roofs – *Table C402.1*

Roofs	2011 CBES	2015 CBES	Semiheated – ASHRAE 2013 Table 5.5-6
Roof: Insulation entirely above deck	R-30 ci U – 0.032	R-30 ci U – 0.032	R-15 ci U – 0.063
Metal Buildings	*Multiple Options* U-0.049	R-25 + R-11 LS U-0.031	R-19 + R-19 U-0.060
Attic and other	R-38 U-0.027	R-49 U-0.021	R-30 U-0.034

CI = continuous insulation

LS = Liner System

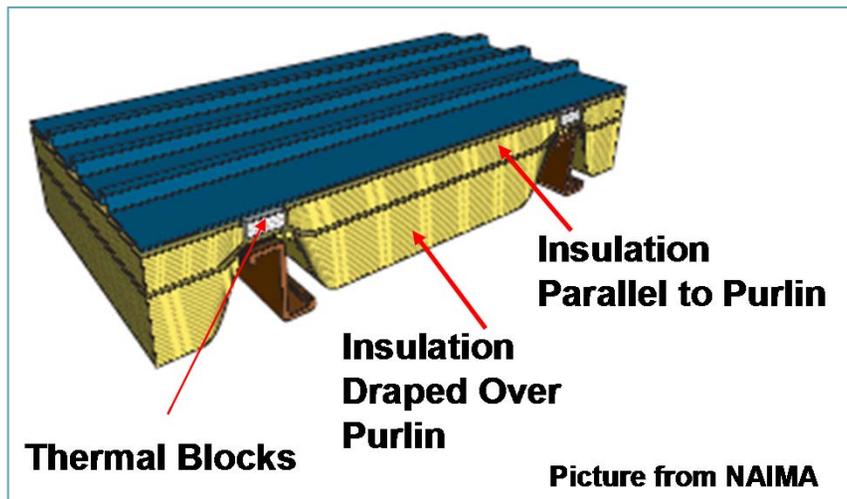
Roof Assembly: Insulation Placed on Suspended Ceiling with Removable Ceiling Tiles



- **Will not count for code compliance**
- **Not considered part of the minimum thermal resistance of the roof insulation**



Roof R-Value: Metal Buildings



Thermal spacer block required on all metal buildings or must use U-factor Compliance Method

Two layers of insulation required
✓ R-25+R-11 LS

Liner System (LS) includes

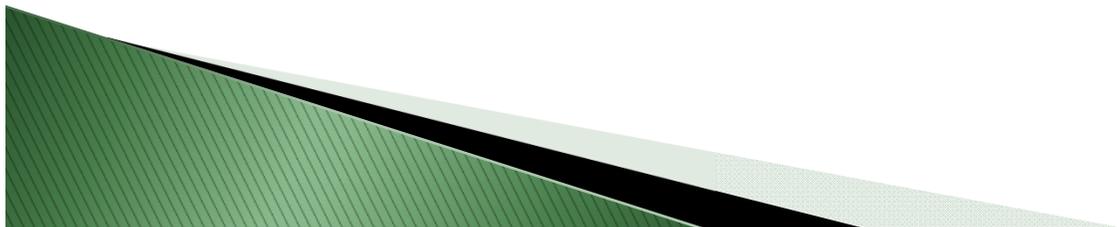
- Continuous vapor barrier liner membrane installed below purlins and is uninterrupted by framing members
- An uncompressed, unfaced insulation resting on top of liner membrane and located between purlins
- Multilayer installations, the last rated R-value of insulation is for unfaced insulation draped over purlins and compressed when metal roof panes are attached

Building Envelope: Above-Grade Walls – Table C402.1

Walls – Above Grade	2011 CBES		2015 CBES		Semiheated ASHRAE 2013 Table 5.5-6
Mass	R-13.3 ci U-0.080	[GROUP R] R-15.2 ci U-0.071	R-13.3 ci U-0.080	[GROUP R] R-15.2 ci U-0.071	R-5.7 ci U - 0.151
Metal building	R-11 + R-13 ci or R-19.5 ci U-0.054		R-13 + R-13 ci or R-19.5 ci U-0.052		R-0 + R-9.8 ci U-0.094
Metal-framed	R-13+R-7.5ci or R-13 ci U-0.064		R-13+R-7.5 ci or R-13 ci U-0.064		R-13 + R-3.8 ci U-0.084
Wood-framed and other	R-13+R-7.5 ci or R-20 + R-3.8 ci or R-23 <i>or</i> R-15 ci U-0.051		R-13+R-7.5 ci or R-20 + R-3.8 ci or R-23 <i>or</i> R-15 ci U-0.051		R-13 U-0.089

Building Envelope: Below-Grade Walls, *Table C402.1*

Walls- Below Grade	2011 CBES	2015 CBES	Semiheated ASHRAE 2013 Table 5.5-6
Below Grade Wall	R-10 ci C-0.092	R-10 ci C-0.092	R-7.5ci C-0.119



Below Grade Walls: *Table C402.1*

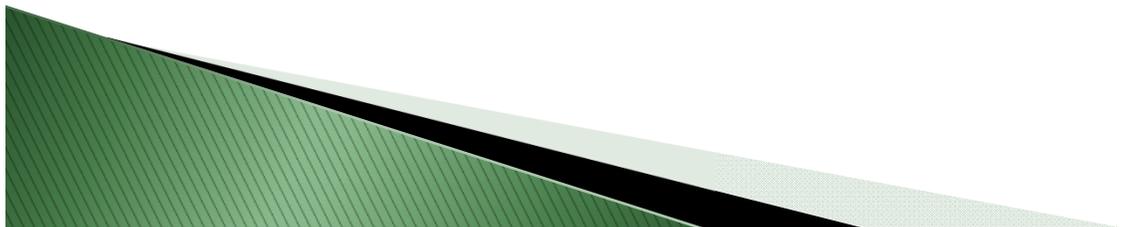
What is a below grade wall?

- ✓ Basement or first-story walls \geq 85% below grade

Insulation must extend down 10 ft from outside finished grade level or to the level of lowest floor, whichever is less

Heated slabs installed below grade (*footnoted to Table C402.1*)

- ✓ Below grade walls must meet exterior insulation requirements for heated slabs



Building Envelope: Floors – Table C402.1

Floors	2011 CBES		2015 CBES		Semiheated ASHRAE 2013 Table 5.5-6
Mass	R-12.5ci	[Group-R] <i>None</i>	R-12.5ci	[Group-R] R-14.6 ci	R-8.3 ci
	U-0.064		U-0.064	U-0.057	U-0.087
Joist/ Framing- Metal	R-30	[Group-R]	R-38	[Group-R]	R-19
	U-0.038	R-38 U-0.032	U-0.032	R-38 U-0.032	U-0.052
Joist/ Framing- Wood and Other	R-30		R-30		R-19
	U-0.033		U-0.033		U-0.051

Floors Over Outdoor Air or Unconditioned Space

Section C402.2.4



Joist/Framing (Steel/Wood)

- Insulation installed between framing

Mass Floors

- Materials weighing (of floor surface area) 35 lbs/ft², or
- 25 lbs/ft² if material weight is ≤ 120 lbs/ft³
- Insulation installed continuously

- ▶ Floor framing cavity insulation or structural slab insulation should be installed to maintain permanent contact with underside of subfloor decking or structural slabs (with some exceptions)

Building Envelope: Slab-on-Grade: *Table C402.1*

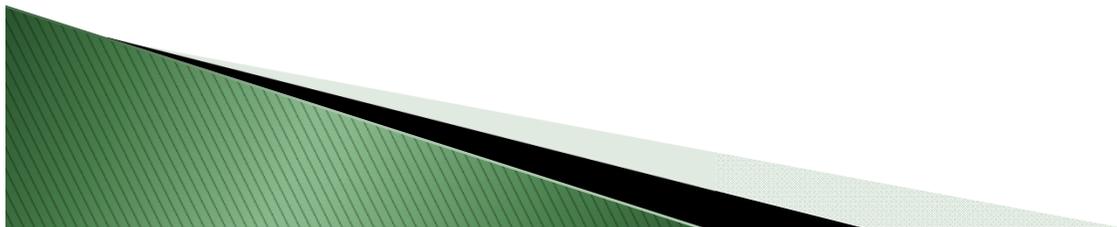
Slab-on-Grade Floors*	2011 CBES	2015 CBES		Semiheated ASHRAE 2013 Table 5.5-6
Unheated	R-10 for 48 inches F-0.48	R-10 for 48 inches F-0.48	[Group-R] R-15 for 48 inches F-0.45	NR
Heated	R-10 for entire slab (under slab and perimeter) F-0.55	R-10 for entire slab (under slab and perimeter) F-0.55		R-15 for 24 in.

Insulation of Radiant Heating Systems: *Section C402.2.6*

Radiant heating system panels and associated components

- Installed in interior or exterior non-slab assemblies to be insulated with $\geq R-3.5$ on all surfaces not facing the space being heated
- ▶ Installed in building thermal envelope should be separated from exterior of building or unconditioned or exempt spaces by not less than R-value installed in opaque assembly in which they are installed or assembly comply with assembly insulation factor method

Exception: heated slabs-on-grade insulated in accordance with slab-on-grade requirements



Building Envelope: Opaque Doors – *Table 402.1*

Opaque Doors	2011 CBES	2015 CBES	Semiheated ASHRAE 2013 Table 5.5-6
Swinging	U-0.37	U-0.37	U-0.70
Non-Swinging*	U-0.20 (R-5)	R-4.75	U-0.50
Upward-Acting or Sectional	R-10	R-10	NA

* Labeled *Roll-Up or Sliding* in 2011 CBES

Upward-Acting or Sectional is unique to Vermont code

Building Envelope: Fenestration – *Table C402.3*

Vertical fenestration		
U-factor		
Fixed Fenestration	0.36	
Operable Fenestration	0.43	
Entrance doors	0.77	
SHGC		
Orientation	South / East / West	North
PF < 0.2	0.40	0.53
$0.2 \leq \text{PF} < 0.5$	0.48	0.58
PF ≥ 0.5	0.64	0.64
Skylights		
U-factor	0.50	
SHGC	0.40	

Building Envelope: Fenestration – Semiheated Space

Semiheated – ASHRAE 2013: Table 5.5-6	
Vertical Fenestration 0% to 40% of Wall	U-factor
Nonmetal framing, all	U-0.45
Metal framing, fixed	U-0.51
Metal framing, operable	U-0.59
Metal framing, entrance door	U-0.77
Skylights – 0% to 3% of Roof	
All types	U-0.85
SHGC	NR

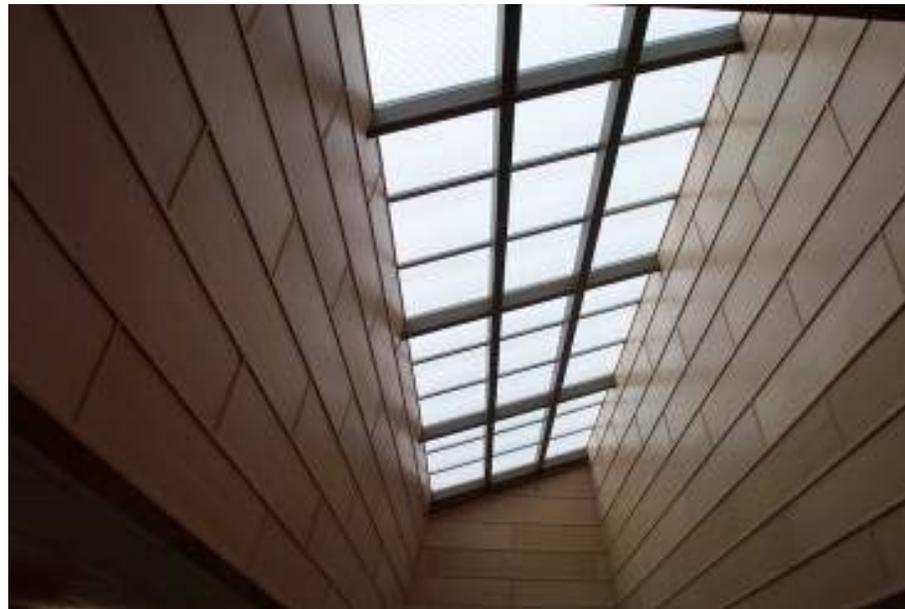
Increased Vertical Fenestration with Daylight Responsive Controls: *Section C402.3.1.1*

- ✓ Up to 40% vertical fenestration area allowed, provided
 - No less than 50% of conditioned floor area is within a daylight zone in buildings < 2 stories above grade
 - No less than 25% of net floor area is within a daylight zone in building \geq 3 stories above grade
 - Daylight responsive controls complying with C405.2.3.1 are installed in daylight zones
 - Vertical Transmission (VT) of vertical fenestration is \geq 1.1 times SHGC

Exception: Fenestration that is outside scope of National fenestration Rating Council (NFRC) 200 isn't required to comply with Vertical Transmission

Skylight Minimum Fenestration Area: *Section C402.3.1*
Prescriptive

- ✓ Limited to $\leq 3\%$ of Roof Area
- ✓ Up to 5% allowed if automatic daylighting controls installed in daylight zones under skylights per C405.2.3.1



Alterations – Skylight Area: *Section C503.3.3*

- Addition of *skylight* area resulting in total building *skylight* area $\leq 3\%$ comply with C402.3
- Addition of *skylight* area resulting in total building skylight area $> 3\%$ comply with C402.3.1.2 for space adjacent to new skylights
 - $\leq 5\%$ with *daylight responsive controls*
- *Alterations* resulting in total building skylight area $> 5\%$ comply with C407 System Commissioning
 - $> 5\%$ and verify *daylight responsive controls*

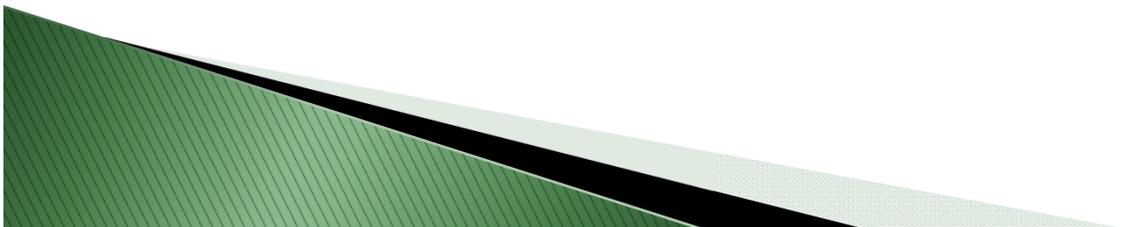
Minimum skylight fenestration area: *Section C402.3.2*

If enclosed space $> 2,500 \text{ ft}^2$ and high bay (> 15 feet) **and**

- And in a certain area, e.g. office, lobby, warehouse, retail store, convention center, etc.
- ▶ Then, total *daylight zone* under skylights shall be not $< 50\%$ of floor area **and**
 - At least 3% skylight area to daylight zone under skylights (Vertical Transmittance ≥ 0.40) **OR** Minimum skylight aperture of 1%
 - Daylight responsive controls required in all qualifying zones under skylights
- **Exceptions**
 - Spaces with Lighting Power Density $< 0.5 \text{ W/ft}^2$
 - Areas where sunlight blocked on $\geq 50\%$ of roof over enclosed area for more than 1,500 daylight hours/year between 8am–4pm
 - Spaces where daylight zone under rooftop monitors $> 50\%$ of enclosed space area
 - Spaces where total area less area of daylight zones adjust to vertical fenestration $< 2,500 \text{ ft}^2$ and where lighting is controlled per C405.2.5

Haze Factor: *Section C402.3.2.2*

- ▶ Skylights in certain space types to have a glazing material or diffuser with a measured haze factor $> 90\%$ per ASTM D 1003
 - Office, storage, automotive service, manufacturing, nonrefrigerated warehouse, retail store, and distribution/sorting area
- ▶ Exception
 - Skylights designed and installed to exclude direct sunlight entering the occupied space by use of fixed or automated baffles, or the geometry of skylight and light well



Air Leakage: *Section C402.4*

- No change from 2011 CBES
- Mandatory continuous air barrier
 - Three air barrier compliance options
 - Option 1: Materials C402.4.1.2.1
 - Option 2: Assemblies 402.4.1.2.2
 - Option 3: Building Test (0.50 cfm/ft² of shell area (excluding area of slab and below grade walls) @ 50 Pa)
 - Air Barrier penetrations—explicit language on air sealing
 - Fenestration air leakage table



Air Barriers and Construction: *Section C402.4.1.1*

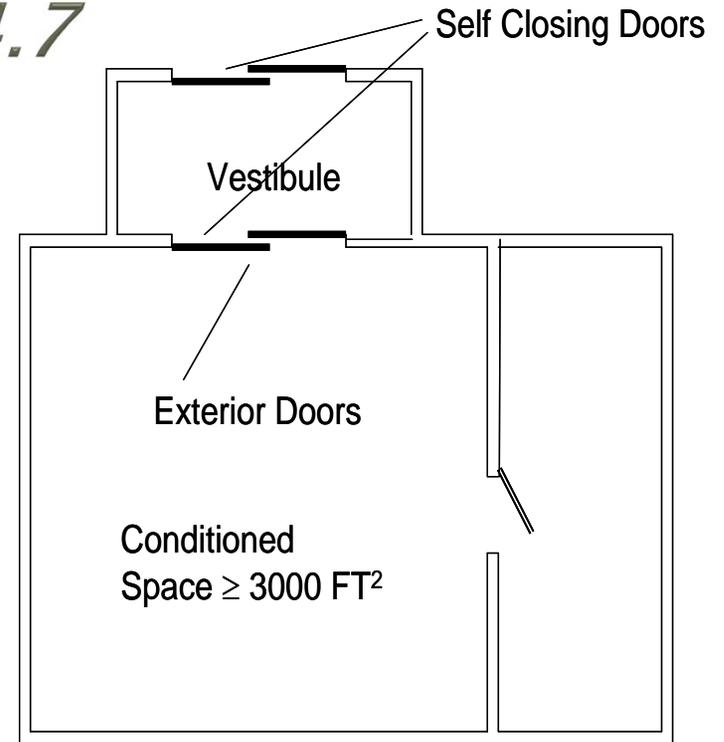
- ▶ **Penetrations of air barrier and air leakage paths to be caulked, gasketed or otherwise sealed in manner compatible with construction materials and location**
- ▶ **Joints and seals**
 - Sealed in same manner or taped or covered with moisture vapor-permeable wrapping material
- ▶ **Sealing of concealed fire sprinklers where required in manner recommended by manufacturer**
 - Caulking or other adhesive sealants should not be used to fill voids between fire sprinkler cover plates and walls, or ceilings
- ▶ **Recessed lighting to comply with C402.4.7**
- ▶ **Where similar objects are installed that penetrate air barrier, make provisions to maintain air barrier's integrity**

Vestibules: *Section C402.4.7*

- Required to reduce infiltration into spaces
- Required on entrance doors leading into spaces $\geq 3,000$ ft²
- Doors must have self-closing devices

Exception

- Revolving doors
 - The installation of one or more revolving doors in the building entrance shall not eliminate the requirement that a vestibule be provided on any doors adjacent to revolving door
- Plus other exceptions



C402.4.7.1 Vestibule tempering

- ▶ Maximum 55°F heating temperature setting
- ▶ Mechanical cooling prohibited

Code Changes C403 Building Mechanical Systems

Summary of Major Changes: Mechanical Systems

- ▶ Mechanical section reorganized for clarity
- ▶ Economizer fault detection on systems ≥ 20 tons
- ▶ Demand Controlled Ventilation threshold expanded
- ▶ Ventilation controls for parking garages reduces fan energy use
- ▶ Expanded range of systems required to use energy recovery; 20% minimum threshold
- ▶ Increased duct insulation from R-10 to R-12 in unconditioned / exterior applications
- ▶ New requirements for refrigeration systems reflect recent national standards

Mechanical Systems: *Section C403*

▶ Sub-sections re-organized

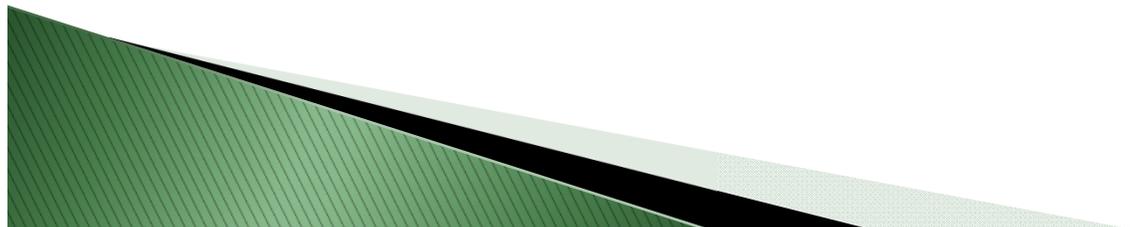
- C403.1 General
- C403.2 Mandatory Provisions (all systems)
 - Sizing; performance requirements; HVAC system controls; economizer fault detection and diagnostics (FDD) **[NEW]**; DCV; parking garage ventilation **[NEW]**; energy recovery; kitchen exhaust **[NEW]**; duct/pipe insulation; refrigeration equipment performance **[NEW]**;
- C403.3 Economizers (Prescriptive)
- C403.4 Hydronic and multiple-zone HVAC systems controls and equipment (Prescriptive)
- C403.5 Refrigeration systems **[NEW]**

Building Mechanical Systems

- ▶ Systems and equipment serving building heating, cooling, and ventilation need to comply with Sections C403.2, C403.3 and C403.4 based on the equipment and systems provided
- ▶ Walk-in coolers, walk-in freezers, refrigerated warehouse coolers and refrigerated warehouse freezers shall comply with Section C403.2.15 or C403.2.16
- ▶ Electric resistance prohibition has not changed
 - Heat pump can use during defrost cycle only
 - See list of exceptions, Section C403.1.2

Mechanical Efficiencies: *Table 403.2.3*

Equipment Type	Size	2011 CBES	2015 CBES
Air Conditioners Air Cooled	<65,000 Btu/h	13.0 SEER	13.0 SEER Single Package 14.0 SEER in 2016
Water Source Heat Pump	<17,000 Btu/h	11.2 EER 4.2 COP	12.2 EER 4.3 COP
Gas Fired Furnaces	<225,000 Btu/h	78% AFUE or 80% E _t	78% AFUE or 80% E _t
Air Cooled Chillers	<150 tons	9.562 FL 12.500 IPLV	Path A 10.1 / 13.7 FL Path B 9.7 / 15.8 IPLV



Economizer Fault Detection and Diagnostics: Section C403.2.4.7

- ▶ **Air cooled unitary direct-expansion units and variable refrigerant flow (VRF) units (≥ 20 tons) equipped with economizer shall include fault detection and diagnostics (FDD) system complying with:**
 - **Temperature sensors permanently installed to monitor system operation**
 - Outside air
 - Supply air
 - Return air
 - **Temperature sensors have an accuracy of $+2^{\circ}\text{F}$ over the range of $40^{\circ}\text{F} - 80^{\circ}\text{F}$**
 - **Refrigerant pressure sensors, where used, have an accuracy of $+3\%$ of full scale**

Economizer Fault Detection and Diagnostics: Section C403.2.4.7

- Unit controller capable of providing system status by indicating
 - Free cooling available
 - Economizer enabled
 - Compressor enabled
 - Heating enabled
 - Mixed air low limit cycle active
 - Current value of each sensor
- Unit controller capable of manually initiating each operating mode so that the operation of compressors, economizers, fans and heating system can be independently tested and verified

Economizer Fault Detection and Diagnostics: Section C403.2.4.7

- Unit capable of reporting faults to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats
- FDD system capable of detecting the following faults
 - Air temperature sensor failure/fault
 - Not economizing when the unit should be economizing
 - Economizing when the unit should not be economizing
 - Damper not modulating
 - Excess outdoor air

Demand Controlled Ventilation: *Section C403.2.6.1*

DCV must be provided for each zone with spaces $> 500 \text{ ft}^2$ and average occupant load ≥ 40 **25** people / 1000 ft^2 of floor area where HVAC system has

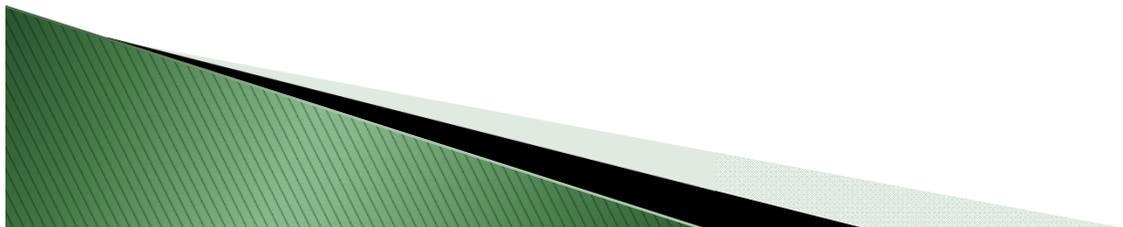
- An air-side economizer, or
- Automatic modulating control of the outdoor air damper, or
- A design outdoor airflow $> 3,000 \text{ cfm}$

Demand control ventilation (DCV): a ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.

Demand Controlled Ventilation: *Section C403.2.6.1*

***DCV* exceptions remain unchanged**

- Systems with energy recovery per C403.2.7
- Multiple zone systems without direct digital control of single zones communicating with central control panel
- Systems with design outdoor airflow < 1,200 cfm
- Spaces where supply airflow rate minus any makeup or outgoing transfer air requirement < 1,200 cfm
- Ventilation provided for process loads only



Enclosed parking garage ventilation controls

Section C403.2.6.2

- ▶ **Requires contamination-sensing devices and automatic controls, configured to**
 - Stage fans or modulate fan average airflow rates to 50% or less of design capacity, *or*
 - Intermittently operate fans less than 20% of occupied time
 - ***Exceptions***
 - Garages with total exhaust capacity $< 22,500$ cfm with no heating / cooling
 - Garages with garage area to ventilation system motor nameplate power ratio $> 1,125$ cfm/hp with no heating or mechanical cooling

Energy Recovery Ventilation Systems

Section C403.2.7

2011 CBES: systems

- > 5,000 CFM supply air; and
- > 70% outdoor air

2015 CBES: Expands requirement to systems

- All systems > 8,000 hours/year
- < 8,000 hours/year
 - > 20% outdoor air at full design airflow
 - minimum supply CFM per Table 403.2.7(1)

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)							
NR	≥ 16,000	≥ 5,500	≥ 4,500	≥ 3,500	≥ 2,000	≥ 1,000	> 0

Energy Recovery Ventilation Systems

Section C403.2.7

Exceptions

- Where energy recovery is prohibited by IMC
- Lab fume hood system meeting certain criteria
- Systems serving uncooled spaces and heated to $< 60^{\circ}\text{F}$
- Where $> 60\%$ of outdoor heating energy is from site-recovered or site solar energy
- Systems requiring dehumidification that employ energy recovery in series with the cooling coil
- Where largest source of air exhausted at a single location at building exterior is $< 75\%$ of design outside air flow rate
- Systems expected to operate < 20 hours / week at outdoor air % covered by Table C403.2.7(1)
- Systems exhausting toxic, flammable, paint or corrosive fumes or dust
- Commercial kitchen hoods used for collecting and removing grease vapors and smoke (Covered in Section C403.2.8)

Duct and Plenum Insulation & Sealing

Section C403.2.9

Insulation required for supply and return ducts and plenums

- Located in unconditioned space:
 - minimum R-8
 - duct or plenum within building envelope assembly shall be separated from building exterior or unconditioned or exempt spaces by minimum ~~R-10~~ **R-12**
- Duct located outside the building requires minimum ~~R-10~~ **R-12**



Exceptions

- When located within equipment
- When design temperature difference between interior and exterior of the duct or plenum doesn't exceed 15°F

Fan Efficiency: *Section C403.2.12.3* <New>

- ▶ Have a fan efficiency grade (FEG) < 67 determined by approved testing laboratory or labeled by manufacturer
- ▶ Total efficiency at design point of operation must be within 15 percentage points of maximum total efficiency of fan
- ▶ Exceptions
 - Fans of ≤ 5 hp
 - UNLESS Multiple fans in series or parallel are operated as the functional equivalent of a single fan exceed 5 hp
 - Wall / roof ventilators
 - Fans in unitary equipment
 - Plus other exceptions

Refrigeration Equipment Performance: *Section C403.2.14*

- ▶ Applies to commercial reach-in units; walk-ins and refrigerated warehouses covered in C403.2.15 and C403.2.16
- ▶ Equipment kWh/day energy use \leq Tables C403.2.14(1-2) values when tested and rated in accordance with AHRI Standard 1200
- ▶ Energy use shall be verified through certification under approved certification program or if no certification program existing, energy use shall be supported by data furnished by equipment manufacturer

Walk-in Coolers, Walk-in Freezers, Refrigerated Warehouse Coolers/Freezers, Display Cases: *Section C403.2.15 & C403.2.16*

Requirements include

- Be equipped with automatic door-closers
- Doorways have strip doors, curtain, spring hinged doors or other approved method of minimizing infiltration
- Walk-in coolers and refrigerated warehouse coolers shall have wall, ceiling, and door insulation of $\geq R-25$ and walk-in freezers and refrigerated warehouse freezers $\geq R-32$
 - Exception - glazed portions of doors or structural members need not be insulated
- Walk-in freezers floor insulation $\geq R-28$

Walk-in Coolers, Walk-in Freezers, Refrigerated Warehouse Coolers/
Freezers, Display Cases: *Section C403.2.15 & C403.2.16*

- Transparent reach-in doors for walk-in freezers and windows in walk-in freezer doors shall be triple-pane
- Windows and transparent reach-in doors for walk-in coolers, doors shall be of double-pane
- Evaporator fan motors < 1 hp use ECM, brushless direct-current motors, or 3-phase motors
- Condenser fan motors < 1 hp use ECM, PSC, or 3-phase motors
- Power limits on antisweat heaters without controls
- Antisweat heater controls must control as a function of relative humidity in the air outside the door or of the condensation on the inner glass plane

Economizers: *Section C403.3*

Air or Water Economizers Required when

- Individual DX cooling units $\geq 54,000$ Btu/h
- Economizer (usually central water economizer) on any chilled water cooling unit if total cooling exceeds 1,320,000 Btu/h for local water-cooled systems or 1,720,000 Btu/h for air-cooled or district systems
- Note: Total capacity of all fan-cooling units without economizers shall not exceed 20% of total capacity of all fan-cooling units or 300,000 Btu/h, whichever is greater
- Other exceptions apply

Economizer Integration Controls: *Section C403.3.1*

- ▶ **Systems to be integrated with mechanical cooling system and capable of providing partial cooling even where additional mechanical cooling is required to provide remainder of cooling load**
- ▶ **Controls shall not be capable of creating a false load in mechanical cooling systems by limiting or disabling economizer or any other means, such as hot gas bypass, except at lowest stage of mechanical cooling**

Water-side Economizers: *Section C403.3.4*

Capable of cooling supply air by indirect evaporation and provide up to 100% of expected system cooling load at outdoor air temperatures < 50°F dry bulb / 45°F wet bulb

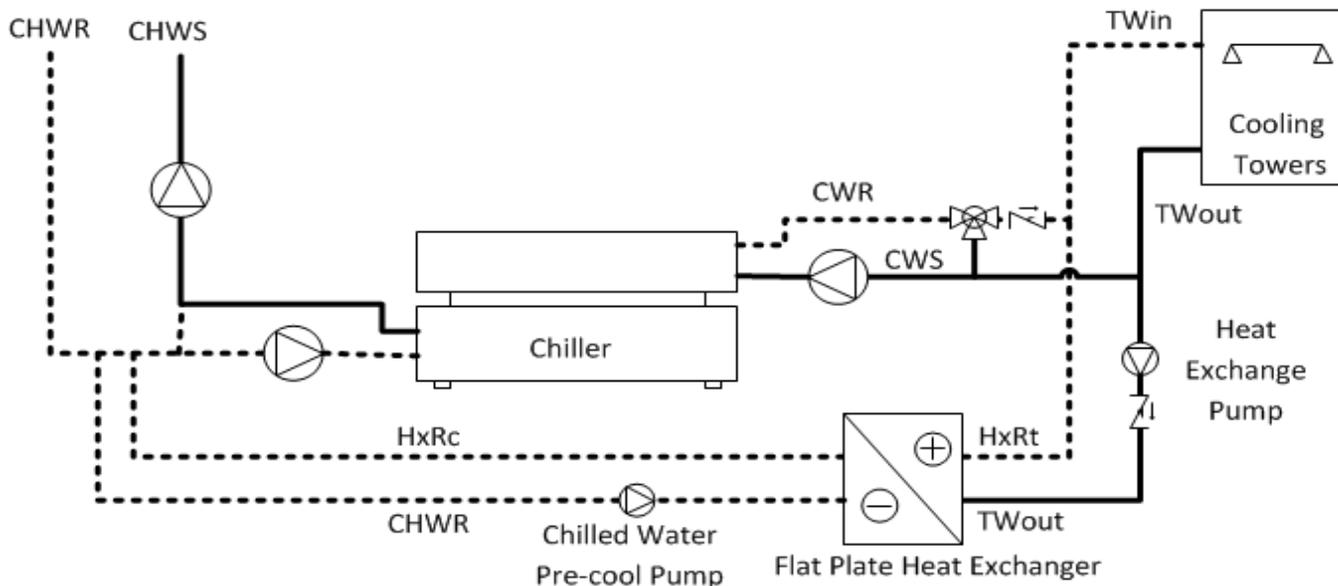
Exceptions

- Systems primarily serving computer rooms in which 100% of expected system cooling load at 40°F dry bulb / 35°F wet bulb is met with evaporative water economizers
- Systems primarily serving computer rooms with dry cooler water economizers which satisfy 100% of the expected system cooling load at 35°F dry bulb
- Systems where dehumidification requirements cannot be met using outdoor air temps of 50°F dry bulb / 45°F web bulb and where 100% of expected system cooling load at 45°F dry bulb / 40°F wet bulb is met with evaporative water economizers

Water-side Economizers: *Section C403.3.4*

Precooling coil and water-to-water heat exchangers used as part of a water economizer system to have either

- ▶ water side pressure drop < 15 feet of water OR
- ▶ secondary loop created so that the coil or heat exchanger pressure drop is not seen by the circulating pumps when the system is in normal cooling (non-economizer) mode



Refrigeration Systems: *Section C403.5*

Remote compressors and condensers

- Fan-powered condenser requirements
 - Saturated condensing temperatures for air-cooled condenser not to exceed:
 - Dry-bulb temp. plus 10°F for low-temp. refrigeration systems
 - Dry-bulb temp. plus 15°F for medium temp. refrigeration systems
 - Condenser fan motors < 1 hp: ECM, PSC or 3-phase motor
 - Variable speed controls required
 - Multiple fan condensers controlled in unison
 - Minimum condensing temperature setpoint < 70°F

Refrigeration Systems: *Section C403.5*

- ▶ **Remote compressors and condensers**
 - **Compressors**
 - Floating suction pressure control logic to reset target suction pressure temperature
 - Exception: controls are not required for
 - Single-compressor system that do not have variable capacity capability
 - Suction groups with saturated suction temperature $\geq 30^{\circ}\text{F}$
 - Suction groups that comprise the high stage of a two-stage or cascade system
 - Suction groups that primarily serve chillers for secondary cooling fluids

Refrigeration Systems: *Section C403.5*

- ▶ **Remote compressors and condensers**
 - **Compressors**
 - Liquid subcooling required for all low-temperature compressor systems with a design cooling capacity $\geq 100,000$ Btu/hr with saturated suction temp. $\leq -10^{\circ}\text{F}$
 - Sub-cooled liquid temp. to be controlled at maximum temperature setpoint of 50°F at the exit of the subcooler using either compressor economizer ports or separate compressor suction group operating at saturated suction temperature $\geq 18^{\circ}\text{F}$
 - Compressors that incorporate internal or external crankcase heaters must provide a means to cycle heaters off during compressor operation

Code Changes C404 Service Water Heating

Yes, that is David Hasselhoff



Summary of Major Changes: Service Water Heating

- ▶ New efficiency requirement ($\geq 90\%$ thermal efficiency) for high-input service hot water systems ($\geq 1,000,000$ Btu/h)
- ▶ New methods introduced for reducing energy waste through hot water piping
- ▶ Controls required for hot water circulation pumps to reduce pump energy use
- ▶ *****5 kW electric water heater limit remains***

High Input-rated Service Water heating Systems

Section C404.2.1

Gas-fired equipment installed in new buildings

- ▶ Single piece serves entire building with input rating ≥ 1 Million Btu/h
 - Thermal efficiency $\geq 90\%$
- ▶ Multiple pieces w/combined input rating ≥ 1 MM Btu/h
 - Combined input-capacity, wgt-avg. thermal efficiency $\geq 90\%$

Exceptions

- 25% of annual SWH requirement is provided by site-solar or site-recovered energy
- Input rating of water heaters installed in individual dwelling units
- Individual units with input rating $\leq 100,000$ Btu/h not included in total SWH input for the building

Heat Traps: *Section C404.3*

Equipment not supplied with integral heat traps and serving non-circulating systems must have heat traps on supply and discharge piping associated with equipment



Efficient Heated Water Supply Piping: *Section C404.5*

For piping from *nearest source of heated water* (from water heater or from recirculation or trace heated loop) to fixture **requires either maximum pipe length (C404.5.1) or maximum pipe volume (C404.5.2), and maximum flow rated by size**

- ▶ Flow rate through ¼” piping should be ≤ 0.5 gpm
- ▶ Flow rate through 5/16” piping should be ≤ 1.0 gpm
- ▶ Flow rate through 3/8” piping should be ≤ 1.5 gpm

Intent is to reduce wasting previously-heated water cooled in pipes that do not require insulation

Heated-water Circulating and Temperature Maintenance Systems: *Section C404.6*

- ▶ **Circulation Systems**
 - Controlled pump(s) required
 - Demand control required (see C404.7)
 - Gravity and thermosyphon not allowed
- ▶ **Heat Trace Systems**
 - Energy input adjusted to maintain temperature
 - Timed or demand automatic controls
- ▶ **Controls for Hot Water Storage Tank Pumps**
 - Automatic controls limit pump operation to no more than 5 minutes after heater operation

Demand Recirculation Controls: *Section C404.7*

- ▶ Systems with ≥ 1 recirculation pumps from heated-water supply pipe back to heated-water source through cold-water supply pipe must be demand recirculation water system
- ▶ Pumps to have controls that
 - Start pump upon receiving signal from action of user of fixture or sensing flow of hot or tempered water to fixture fitting or appliance
 - Limit temperature of water entering cold-water piping (used as recirculation return) to 104°F

Code Changes C405 Electrical Power and Lighting

Summary of Major Changes: Power & Lighting

- ▶ Change from 50% to 75% minimum high efficacy lights in dwelling units
- ▶ Expanded requirements for spaces with occupancy sensor (OS) controls
 - ▶ Clarified requirements for OS controls to ensure better acceptance and realization of energy savings
- ▶ Lighting power density (Watts/square foot) maximum values aligned with 2015 IECC
- ▶ Efficient lights / fans required in elevators
- ▶ Required controls to reduce speed in escalators when not in use

When do Lighting and Power Requirements Apply?

- ▶ Original Installed Lighting System in New Building, Addition, or Tenant Build-out
- ▶ Existing Lighting System that is Altered
- ▶ Change in Occupancy that Increases Energy
- ▶ Change in Occupancy requiring less LPD (per LPD tables)

Exceptions

- ▶ Alterations where $< 10\%$ of luminaires in a space are replaced and installed interior lgt. power is not increased
 - ENCLOSED SPACE – volume surrounded by solid surfaces such as walls, floors, roofs, and operable devices, such as doors and operable windows
- ▶ Lighting within dwelling units
 - Where $\geq 75\%$ of permanently installed fixtures (except low-voltage) are fitted for and include high-efficacy lamps
- ▶ Walk-in coolers, walk-in freezers, refrigerated warehouse coolers, and refrigerated warehouse freezers comply with C403.2.15 or C403.2.16

What's Covered Under Electrical Power and Lighting Systems Requirements?

- **Mandatory Interior Lighting requirements**
 - Required Controls
 - Wattage / Efficiency Limits
- **Interior Lighting Power Density Allowances (W/ft²)**
- **Exterior Lighting Controls**
 - Required Controls
 - Lamp Efficiency
- **Exterior Lighting Power Density Allowances (W/ft²)**
- **Electric Metering**
- **Electrical Transformers and Motors**
- **Vertical and Horizontal Transportation Systems and Equipment**



What's Covered Under Electrical Power and Lighting Systems Requirements?

Exception

- ▶ Dwelling units within commercial building are not required to comply **IF**
 - Minimum of 75% of lamps in permanently installed lighting fixtures are high-efficacy lamps, **or**
 - 75% of permanently installed lighting fixtures contain only high efficacy lamps

Exception

- Low-voltage lighting – equipment powered through transformer, such as
 - cable conductor
 - rail conductor
 - track lighting

High-Efficacy Lamps – Definition

- ✓ Compact fluorescent lamps, T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy based on lamp wattage

Lamp Wattage	Efficacy
> 40 watts	60 lumens / watt
15-40 watts	50 lumens / watt
< 15 watts	40 lumens / watt

Occupant Sensor Controls: *Section C405.2.1*

- ▶ Consistent with ASHRAE 90.1
- ▶ Occupancy sensors required
 - Classrooms/lecture/training rooms
 - Conference/meeting/multipurpose rooms
 - Copy/print rooms
 - Lounges
 - Employee lunch and break rooms
 - Private offices
 - Restrooms
 - Storage rooms
 - Janitorial closets
 - Locker rooms
 - Warehouses
 - Other spaces $\leq 300\text{ft}^2$ enclosed by floor-to-ceiling height partitions

Occupant Sensor Controls: *Section C405.2.1*

C405.2.1.1 Occupant sensor control function

- ▶ Non-warehouses
- ▶ Automatic off within 30 minutes
- ▶ Manual on *or* controlled to turn on to 50% power
- ▶ Incorporate manual control to turn lights off

C405.2.1.2 Occupant sensor control function in warehouses

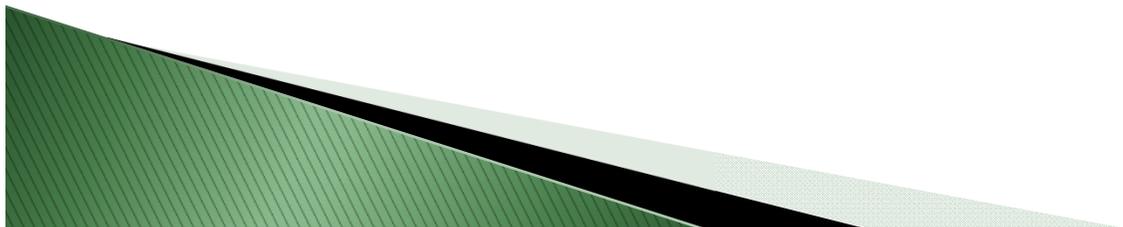
- ▶ Lighting in aisleways and open areas shall be controlled with occupant sensors
 - Automatically reduce lighting power by $\geq 50\%$ when areas are unoccupied
 - Each aisleway controlled independently and shall not control lighting beyond the aisleway being controlled by sensor

Occupant Sensor Controls: *Section C405.2.1.1* *Exemptions*

Exemptions

Full auto-on controls allowed in

- ✓ Public corridors
- ✓ Stairways
- ✓ Restrooms
- ✓ Primary building entrance areas and lobbies
- ✓ Areas where manual-on operation would endanger safety or security of room or occupants



Time-switch Controls: *Section C405.2.2*

Each area of building NOT provided with occupant sensor control must have time-switch control to turn lights off automatically

Exceptions

where manual control can provide light reduction and automatic control is not required

- Sleeping units
 - room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both
 - Such rooms and spaces that are also part of a dwelling unit are not *sleeping units*
- Spaces where patient care is directly provided
- Spaces where an automatic shutoff would endanger occupant safety or security
- Lighting intended for continuous operation
- Shop and laboratory classrooms

Light-reduction Controls: *Section C405.2.2.2*



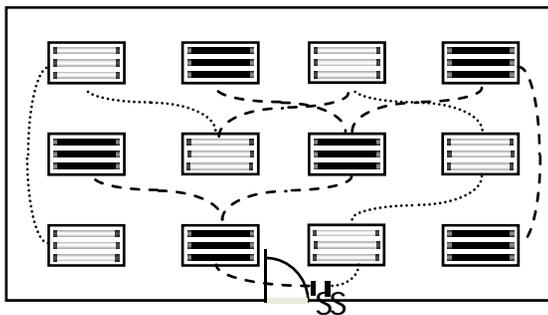
Light Reduction Controls must allow occupant to reduce connected lighting load

- ✓ By at least 50%
- ✓ In reasonably uniform illumination pattern

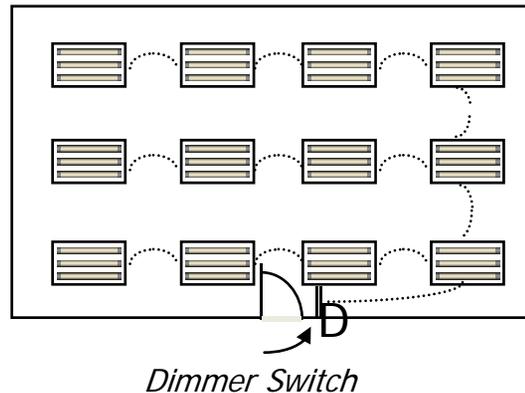
Light-reduction Control Options

- ✓ Controlling all lamps or luminaires
- ✓ Dual switching of alternate rows of luminaires, alternate luminaires or lamps
- ✓ Switching middle lamp luminaires independently from outer lamps
- ✓ Switching each luminaire or each lamp

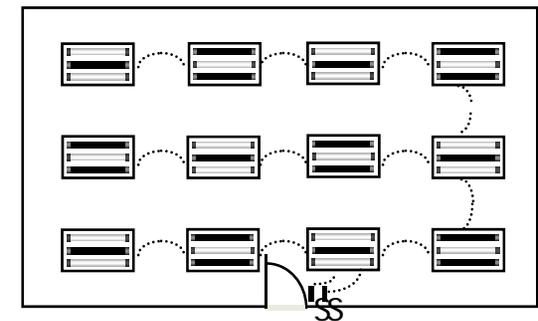
Alternating Luminaires



Dimming



Alternating Lamps



Daylight-responsive Controls: *Section C405.2.3*

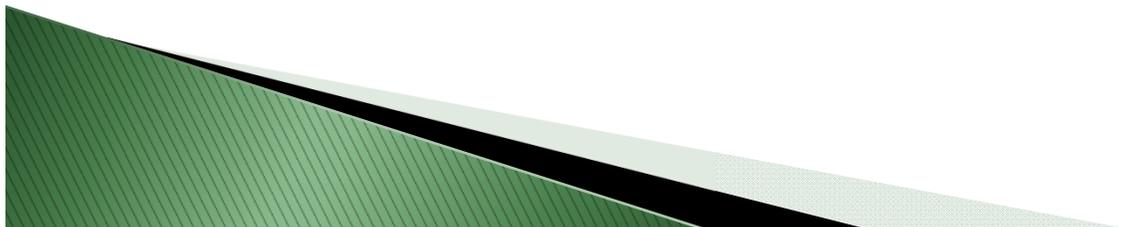
- ▶ **Definition:** A device or system that provides automatic control of electric light levels based on amount of daylight in space
- ▶ **Required to control lighting in spaces with >150 watts of general lighting within each defined zone**
 - Sidelight daylight zones
 - Toplight daylight zones

Exceptions

- Health care facilities where patient care is directly provided
- Dwelling units and sleeping units
- Lighting required for specific application control per C405.2.4
- Sidelight daylight zones on 1st floor above grade in Group A-2 (such as restaurants and banquet halls or buildings containing food preparation areas) and Group M occupancies (Mercantile, such as grocery stores, department stores, gas stations, etc.)

Daylight-responsive Control Functions: *Section C405.2.3.1*

- ▶ Toplight daylight zones shall be controlled independently of lights in sidelight daylight zones
- ▶ Controls shall be configured and able to be calibrated from within the space by authorized personnel
- ▶ Calibration mechanisms shall be readily accessible
- ▶ In offices, classrooms, laboratories, and library reading rooms, controls shall dim lights continuously from full light output to $\leq 15\%$



Exterior Lighting Control Requirements: *Section C405.2.5*

Other than emergency lighting intended to be turned off during building operation, lighting specifically required to meet health and life and safety requirements or decorative gas lighting systems shall

- Turn off as function of available daylight
- Building façade or landscape have controls that automatically shut off as function of dawn/dusk and set opening and closing time



Lighting Power Densities (W/ft²): *Section C405.4.2*

- ▶ LPDs equal to 2015 IECC
- ▶ Building Area and Space-by-Space methods remain

Building Area Type	2011 CBES	2015 CBES
Office	0.90	0.82
Retail	1.40	1.26
Fire Station	0.80	0.67
Warehouse	0.60	0.60

(partial table)

Space-By-Space Method: *Table C405.4.2(2)*

Common Space-by-Space Types	LPD (w/ft ²)
Atrium - First 40 feet in height	0.03 per foot in total height
Atrium - Above 40 feet in height	0.40+0.02 per foot in total height
Audience/seating area - permanent	
In an auditorium	0.63
In a convention center	0.82
In a gymnasium	0.65
In a motion picture theater	1.14
In a penitentiary	0.28
In a performing arts theater	2.43
Classroom / lecture hall / training room	
In a penitentiary	1.34
Otherwise	1.24

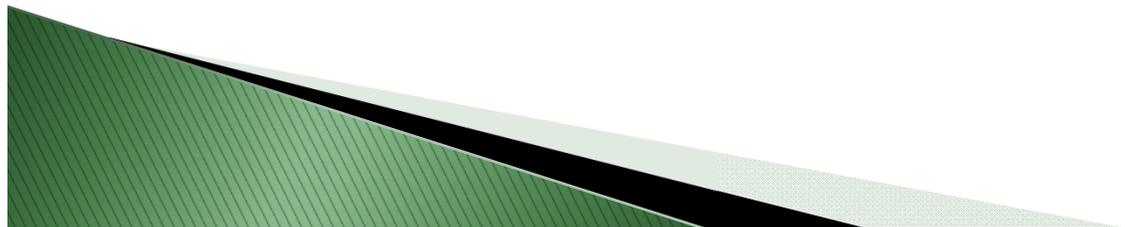
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Exterior Lighting Zones: *Table C405.5.2(1)*

Power allowances are listed by lighting zone

Lighting Zone	Description
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed use areas
3	All other areas not classified as lighting zone 1, 2 or 4
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

Note: no Zone 4 in Vermont



Exterior Lighting Zones: *Table C405.5.2(1)*



Exterior Lighting Zones: *Table C405.5.2(2)*

Allowances include a base allowance plus tradeable allowance

- Only Building Facades have been reduced by ~ 25%

		Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance		500 W	600 W	750 W	1300 W
Tradable Surfaces	Uncovered Parking Areas				
	Parking areas and drives	0.04 W/ft ²	0.06 W/ft ²	0.10 W/ft ²	0.13 W/ft ²
	Building Grounds				
	Walkways less than 10 feet wide	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	1.0 W/linear foot
	Walkways 10 feet wide or greater Plaza areas Special Feature Areas	0.14 W/ft ²	0.14 W/ft ²	0.16 W/ft ²	0.2 W/ft ²
	Stairways	0.75 W/ft ²	1.0 W/ft ²	1.0 W/ft ²	1.0 W/ft ²

Partial Table

Electrical Energy Consumption Mandatory Requirement *Section C405.6*

Separate metering required for each dwelling unit in Group R-2 Buildings; includes permanent occupancy > 2 dwelling units - apartments, boarding houses, dormitories, etc. (not hotel/motel)



Horizontal/Vertical Transport: *Section C405.9*

- ▶ **C405.9.1 Elevator cabs**
 - ≥ 35 lumens/watt
 - Ventilation fans < 0.33 Watts/ft²
 - Controls to de-energize when unoccupied > 15 minutes

- ▶ **C405.9.2 Escalators / Moving Walks**
 - Automatic controls to reduce speed

- ▶ **C405.9.2.1 Regenerative drive**
 - Variable frequency regenerative drive that supplies electrical energy to building electrical system

Code Changes C407 System Commissioning

System Commissioning: *Section C407*

- ▶ Placed in new section
- ▶ Fundamental requirements/thresholds remain same
 - Only for new buildings $\geq 50,000$ ft²
 - Equipment performance verification testing required for:
 - Economizers
 - Variable Air Volume (VAV) fan control
 - Part Load Hydronic Controls
 - Lighting Control Systems ***[NEW]***
 - *Occupancy Sensor controls*
 - *Time-switch controls*
 - *Daylight responsive controls*

System Commissioning: *Section C407.2*

▶ Qualifications

- Scope required by section C407.3 shall be completed by project commissioning authority

▶ Commissioning Authority shall

- Have experience as commissioning authority on at least 3 previous projects each at least 20,000 square feet or greater, **and**
- Be an independent third party entity
 - Commissioning Authority shall not be employee of design team, construction team, owner or developer

Occupant Sensor Controls: *Section C407.3.3.1.1*

- Certify location and aiming per manufacturer recommendation
- Test all sensors if project ≤ 7 sensors
- If > 7 sensors, test for each unique combination of sensor type and space geometry
- Where multiples of each unique combination of sensor type and space geometry are provided $\geq 10\%$, but in no case < 1 of each combination shall be tested unless the code official or design professional requires higher percentage to be tested
- Where $\geq 30\%$ of tested controls fail, all remaining identical combinations must be tested

Verify

- Status indicator, verify correct operation
- Lights turn off or down to permitted level within required time
- Auto-on – lights turn on to permitted level when someone enters the space
- Manual on – lights turn on only when manually activated
- Lights aren't incorrectly turned on by movement in nearby areas or by HVAC operation

Time-switch and Daylight Responsive Controls

Section C407.3.3.1.2 & C407.3.3.1.3

▶ Time-switch Controls

- Confirm programmed schedules
- Document schedules for owner
- Verify correct time and date are set
- Verify any battery backup is installed and energized
- Verify override time limit set to ≤ 2 hours
- Simulate occupied condition and verify and document:
 - Lights turn on and off with respective switches
 - Switch only operates lights in enclosed space where switch is located
- Simulate unoccupied condition and verify and document:
 - All nonexempt lights turn off
 - Manual override only operates lighting where it is located
- Additional testing as specified by the *registered design professional*

▶ Daylight Responsive Controls

- Properly located, field-calibrated, and set to have appropriate setpoints and threshold light levels
- Daylight controlled lighting loads adjust to correct levels with available daylight
- Location where calibration adjustments are made is readily accessible only to authorized personnel

Code Changes C501 Existing Buildings

Chapter 5: Existing Buildings – C501 (NEW)

Expanded from minor, confusing section to separate chapter with five parts

- ▶ C501: General (includes historic buildings)
- ▶ C502: Additions
- ▶ C503: Alterations
- ▶ C504: Repairs
- ▶ C505: Change in Occupancy or Use

Note: Existing buildings do not need to comply with Section C406 Additional Efficiency Packages

Historic Buildings: *Section C501.6 Historic Buildings*

- ▶ **Eliminates the blanket exemption**
- ▶ **Exemption now requires**
 - Submission of “Historic Building Exemption Report” to State Historic Preservation Office
 - Demonstrating that compliance would threaten, degrade or destroy historic form, fabric or function of the building

Existing Buildings: *Section C502 – Additions*

Vertical Fenestration: new fenestration that results in total building fenestration area $\leq 30\%$ must comply with C402.3

- ▶ If $> 30\%$ for total building or addition alone, must comply with C402.3.1.1 Increased Vertical Fenestration Area with Daylight Responsive Control for the addition only
- ▶ Additions that result in total building vertical glass $>40\%$ must comply with ASHRAE 90.1–2013 Appendix G Performance Rating Method

Skylight Area: new skylight area that is $\leq 3\%$ complies with C402.3 Fenestration (Prescriptive)

- ▶ If $> 3\%$ for total building or addition alone, must comply with C402.3.1.2 Increased Skylight Area with Daylight Responsive Control for addition only
- ▶ Additions that result in total building skylight area $>5\%$ must comply with ASHRAE 90.1–2013 Appendix G Performance Rating Method

Existing Buildings: *Section C502 – Additions*

- ▶ Mechanical Systems comply with C403
- ▶ Service Water Heating – C404
- ▶ Pools and inground permanently installed spas – C404.9
- ▶ Lighting power and systems – C405
 - Interior comply with addition alone or addition plus existing building
 - Exterior comply with addition alone or addition plus existing

Existing Buildings: *Section C503 Alterations*



- ▶ Code applies to any new construction
- ▶ Unaltered portion(s) do not need to comply
- ▶ Alterations complying with ASHRAE 90.1–2013 do not need to comply with C402–C405
- ▶ Vertical Fenestration and Skylight Area similar to requirements for additions

Change in Space Conditioning: *Section C503.2 Alterations*

Any non-conditioned or low energy space altered to become conditioned space shall be required to be brought into full compliance

Examples

- ▶ **Converting part of an unconditioned warehouse to office space**
 - **Either meet exterior envelope requirements or separately for added thermally-isolated interior space**
- ▶ **Shell building tenant build-out**

Alterations: *Section C503.6 Lighting Systems*

- ▶ Lighting system requirement has biggest impact on existing building energy use
- ▶ $\geq 10\%$ new fixtures in a *space* now triggers all lighting section requirements (was 50%)

Exception: *Alterations* that replace **less than 10 percent** of the luminaires in a space, provided that such *alterations* do not increase the installed interior lighting power

Existing Buildings: *Section R503 Alterations*

Exceptions

- Storm windows over existing fenestration
- Surface-applied window film installed on existing single pane
- Exposed, existing ceiling, wall or floor cavities, if already filled with insulation
- Where existing roof, wall or floor cavity isn't exposed
- Roof recover
- Reroofing for roofs where neither sheathing nor insulation exposed
 - Insulate above or below sheathing
 - Roofs without insulation in the cavity
 - Sheathing or insulation is exposed
- ✓ Lighting alterations, if
 - < 10% of luminaries in space are replaced
 - Only bulbs and ballasts within existing luminaries are replaced (provided installed interior lighting power is not increased)

Existing Buildings: *Section C503 Alterations*

▶ Heating and Cooling

- New HVAC systems and duct systems in alteration comply with Section C403
 - Economizers – new cooling systems in alteration comply with Section C403.3

▶ Service water heating (SWH) systems

- New SWH systems in alteration comply with C404

▶ Lighting Systems

- New Lighting systems in alteration comply with C404
 - Exception – alteration replacing $< 10\%$ of luminaires in a space, provided alteration does not increase installed interior lighting power density (LPD)

Existing Buildings: *Section C504 Repairs*

- ▶ Work on nondamaged components necessary for required repair or damaged components shall be considered part of the repair and not subject to alterations requirements

- ▶ Applicable Repairs
 - Glass-only replacements in an existing sash and frame
 - Roof repairs
 - Replacement of existing doors that separate conditioned space from exterior do not require installation of a vestibule or revolving door, provided an existing vestibule that separates a conditioned space from exterior shall not be removed
 - Repairs where only bulb and/or ballast within existing luminaires in a space are replaced provided the replacement does not increase installed the interior lighting power

Change in Occupancy or Use: Section C505

- ▶ **Spaces undergoing change in occupancy that would result in increase in usage for either (shall comply with code)**
 - fossil fuel
 - electrical energy

- ▶ **Where use in a space changes from one to another in Tables C405.4.2(1) or C405.4.2(2) for Lighting Power Density, installed lighting wattage shall comply with Section C405.4, Interior Lighting Power Requirements**

CBES – For More Information

Barry Murphy
Energy Programs Specialist
Public Service Department
802.828.3183

barry.murphy@state.vt.us

Energy Codes Update Website

http://publicservice.vermont.gov/topics/energy_efficiency/code_update



Efficiency Vermont 2015 Commercial New Construction

Nick Thiltgen

2015 CBES
March 10th, 2015

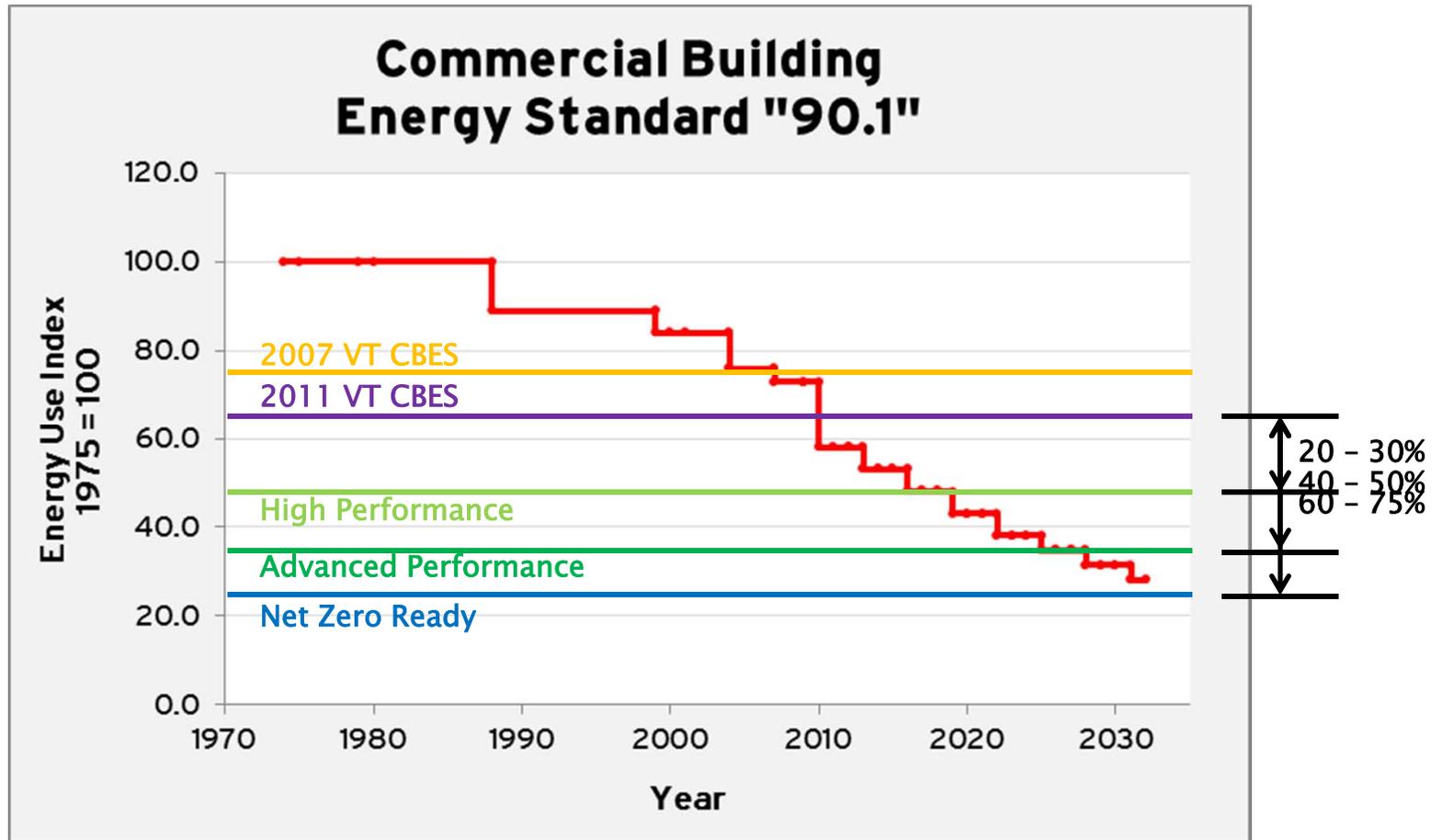
EFFICIENCY VERMONT – PROGRAM

1 Determine your energy efficiency goal and approach

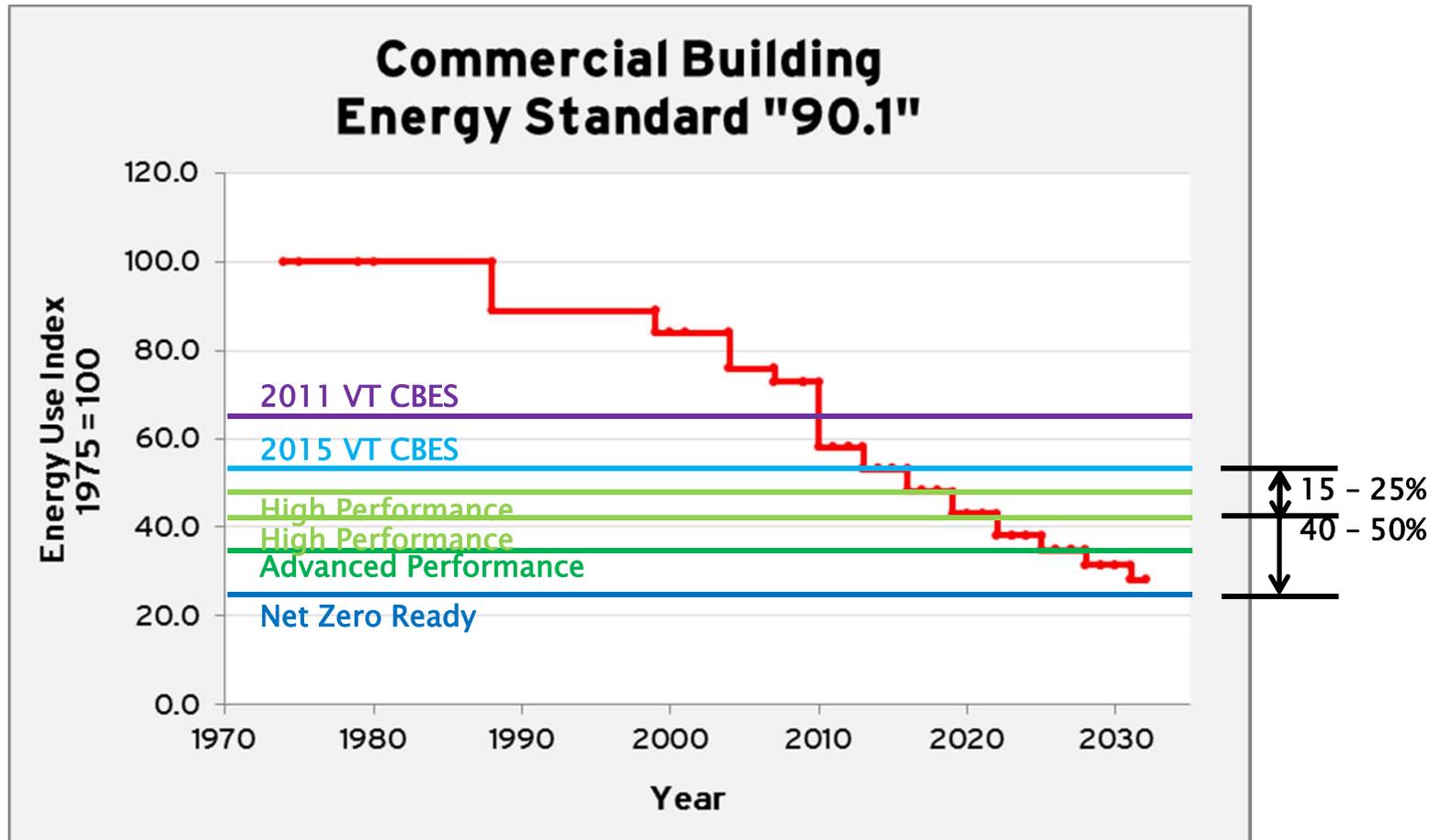


► www.encyvermont.com/cnc

EFFICIENCY VERMONT – PROGRAM



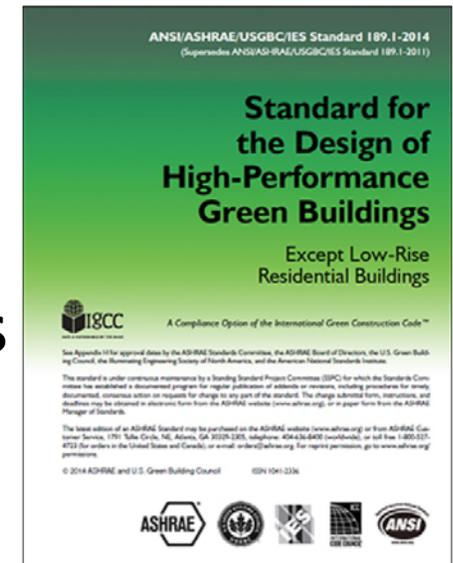
EFFICIENCY VERMONT – PROGRAM



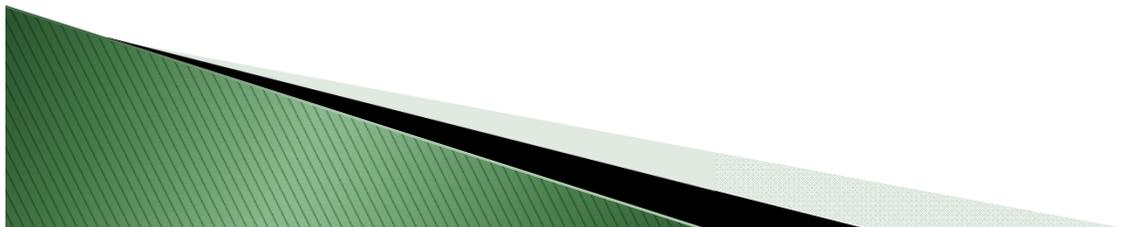
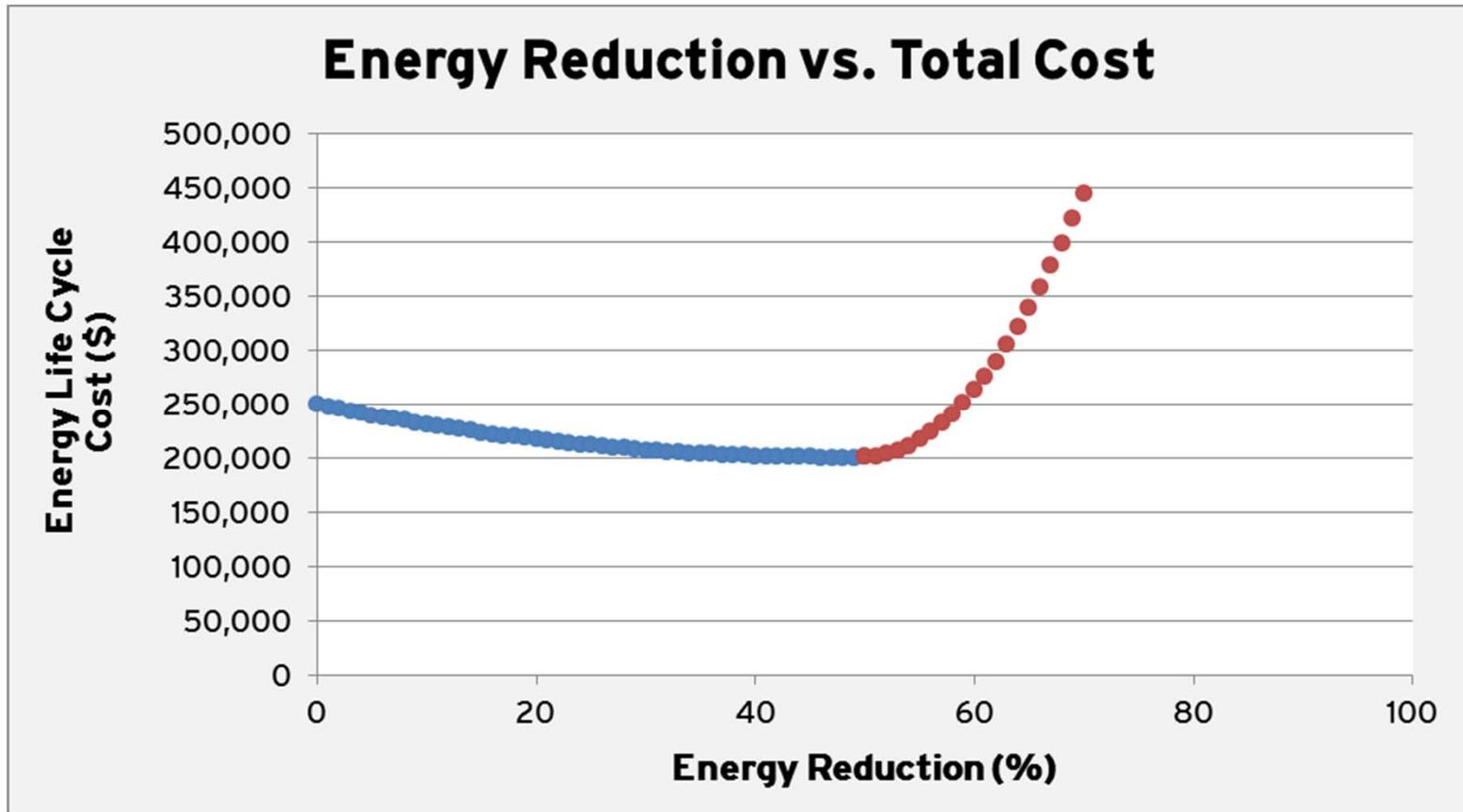
EFFICIENCY VERMONT – PROGRAM

Efficiency Measures

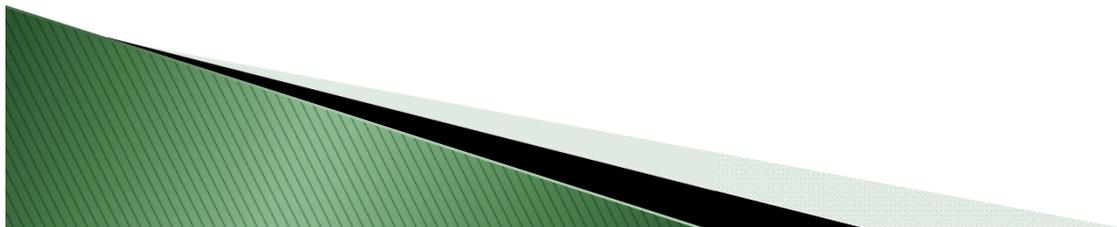
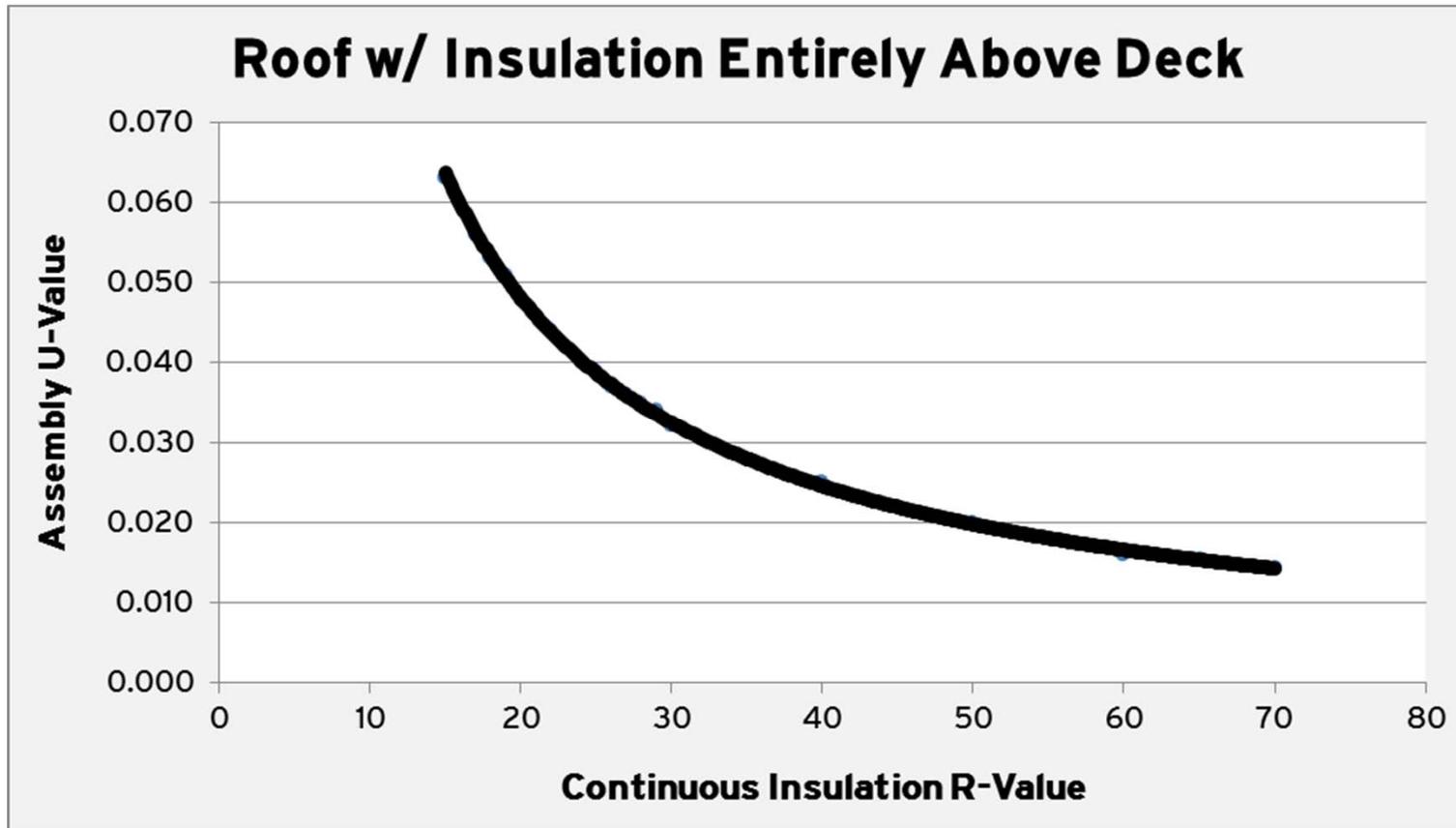
- Building Envelope Insulation & Air Sealing
- Exterior & Interior Lighting Power
- HVAC Equipment Efficiency
- Domestic Water Heater Efficiency & Fixtures
- Building Specific Equipment
- Energy Monitoring
- Building Commissioning



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2 Invite us to a kick-off or early design meeting

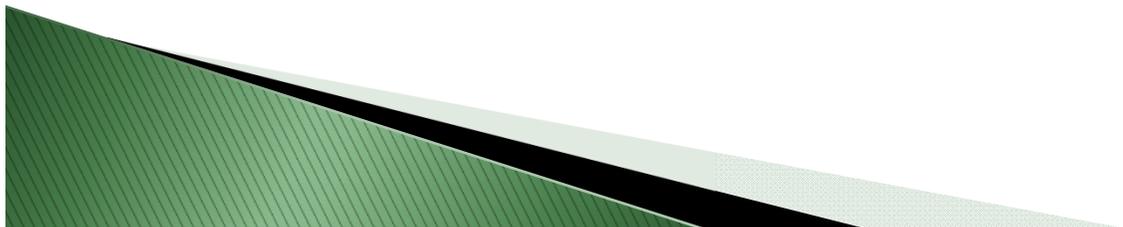


Contact our Project Intake Coordinator at PICS@veic.org or 802-658-6060 X7662 to set up a meeting.



***PLEASE NOTE :** To receive full financial assistance for your project, you must involve Efficiency Vermont at this stage of your process.

3 Work with us to incorporate energy efficiency into design, construction, and operation



EFFICIENCY VERMONT – PROGRAM

Net Zero Energy Building Program

- Energy Efficiency
- Renewable Energy Generation
- Net Zero Design & Performance
- Energy Charrette
- Energy Modeling
- Commissioning
- Energy Metering



Photo Credit: Gossens Bachman Architects

This concludes The American Institute of Architects Continuing Education Systems Course

Provider Name



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