

INTRODUCTION TO THE 2015 VERMONT COMMERCIAL BUILDING ENERGY STANDARDS (CBES)

Better Buildings by Design Conference
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For more information

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

Agenda

- ▶ **Energy Codes Update Background/Overview**
- ▶ **Commercial Energy Code Update**
 - **Scope / Application / Administration**
 - **Envelope**
 - **Mechanical**
 - **Lighting**
 - **Commissioning**
- ▶ **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 Code – under development

▶ Residential (RBES)

- Base Code – March 1, 2015
- Stretch Code – December 1, 2015
 - Act 250 projects

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:

- One- and two-family residential
- R-2, R-3, R-4 three stories or less in height



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 users 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 complying with C402 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

- C402 - Envelope
- C403 - Mechanical
- C404 - SWH
- C405 - Lighting

AND

● Pick One C406:

C406.2 - Eff. HVAC Performance

or

C406.3 - Reduced Lighting Power Density

or

C406.4 - Enhanced Lighting Controls

or

OR

2

ASHRAE 90.1-2013

C406.5 - On-site Supply of Renewable energy

or

C406.6 - Dedicated Outdoor Air System

or

C406.7 - High Eff. Service Water Heating

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
6. Reduced energy use in service water heating

Chapter 5: Existing Buildings (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 C501.5 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 C503 Alterations*



- ▶ Code applies to any new construction
- ▶ Unaltered portion(s) do not need to comply
- ▶ Alterations comply 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 with this code

Examples

- ▶ **Converting part of an unconditioned warehouse to office 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

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 separate 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), installed lighting wattage shall comply with Section C405.4**

Proposed 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 $>2,500$ ft²**

Building Envelope: Roofs

Roofs	2011 CBES	2015 CBES
Roof: Insulation entirely above deck	R-30 ci U - 0.032	R-30 ci U - 0.032
Metal Buildings	*Multiple Options* U-0.049	R-25 + R-11 Ls U-0.031
Attic and other	R-38 U-0.027	R-49 U-0.021

ci = continuous insulation

Building Envelope: Above-Grade Walls

Walls - Above Grade	2011 CBES		2015 CBES	
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
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	
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	
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	

Building Envelope: Below-Grade Walls

Walls–Below Grade	2011 CBES	2015 CBES
	R–10 ci	R–10 ci
Below Grade Wall	C–0.092	C–0.092

Building Envelope: Floors

Floors	2011 CBES		2015 CBES	
Mass	R-12.5ci U-0.064	[Group-R] <i>None</i>	R-12.5 ci U-0.064	[Group-R] R-14.6 ci U-0.057
Joist/ Framing- Metal	R-30 U-0.038	[Group-R] R-38 U-0.032	R-38 U-0.032	[Group-R] R-38 U-0.032
Joist/ Framing- Wood and Other	R-30 U-0.033		R-30 U-0.033	

Building Envelope: Slab-on-Grade

Slab-on-Grade Floors*	2011 CBES		2015 CBES	
Unheated	R-10 for 48 inches	R-10 for 48 inches	R-15 for 48 inches	
Heated	F-0.48	F-0.48	F-0.45	
	R-10 for entire slab (under slab and perimeter)	R-10 for entire slab (under slab and perimeter)		
	F-0.55	F-0.55		

Building Envelope: Opaque Doors

Opaque Doors	2011 CBES	2015 CBES
Swinging	U-0.37	U-0.37
Non-Swinging*	U-0.20 (R-5)	R-4.75
Upward-Acting or Sectional	R-10	R-10

- * Labeled *Roll-Up or Sliding* in the 2011 CBES
- Upward-Acting or Sectional is unique to the Vermont code

Vertical fenestration: *Table C402.4*

- ▶ **Categories re-organized**
- ▶ **Next slides show 2011 CBES
and then 2015 CBES**

Building Envelope: Fenestration

Category	2011 CBES
Vertical Fenestration (Maximum %)	40%
Framing Materials other than Metal with or without Metal Reinforcement or Cladding	U-0.35
Metal framing with or without Thermal Break	
Curtain Wall/Storefront	U-0.42
Entrance Door	U-0.80
All Other	U-0.50
SHGC-All Frame Types	
Projection Factor (PF) < 0.25	0.40
0.25 < PF < 0.5	0.55
PF >= 0.5	NR
Skylights (Maximum %)	3%
Skylights, Glass	U-0.50
	SHGC-0.40

Building Envelope: Fenestration

2015 CBES: 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	

Increased Vertical Fenestration: *Section C402.4.1.1*

- ▶ **C402.4.1.1 Increased vertical fenestration area with daylight responsive controls**
 - 30–40% fenestration area if:
 - Sufficient floor area is in daylight zone
 - Daylight responsive controls installed
 - Visible transmittance (VT) of vertical fenestration is ≥ 1.1 SHGC

- ▶ **C402.4.1.2 Increased skylight area with daylight responsive controls**
 - 3 – 5% skylight area

Minimum skylight fenestration area: *Section C402.4.2*

- ▶ If: $> 2,500 \text{ ft}^2$ and high bay (> 15 feet)
- ▶ Then: total *daylight zone* under skylights shall be not less than half the 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

Air Leakage: *Section C402.4*

- No change from 2011 CBES
- Mandatory continuous air barrier
 - Three air barrier compliance options
 - Option 1: Materials
 - Option 2: Assemblies
 - 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



Proposed 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 403.2.15 or 403.2.16
- ▶ Electric resistance prohibition has not changed

- ▶ **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**
 - **Unit controller capable of providing system status**
 - **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**

**Additional details in CBES*

Demand Controlled Ventilation: *Section C403.2.6.1*

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

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

****Exceptions remain unchanged***

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.

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
 - minimum supply CFM (see table)

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

Duct and Plenum Insulation & Sealing

Section C403.2.9

Insulation required for supply and return ducts and plenums

- Located in unconditioned space:
 - minimum R-6
- Duct located outside the building; duct or plenum within building envelope assembly shall be separated from building exterior or unconditioned or exempt spaces:
 - 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

Refrigeration Equipment Performance: *Section C403.2.14*

- ▶ **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*:**
 - Auto door closers for walk-ins (that have been closed to within 1" of full closure)
 - Walk-in coolers and refrigerated warehouse coolers shall have wall, ceiling, and door insulation \geq R-25 and walk-in freezers and refrigerated warehouse freezers \geq R-32
 - Walk-in freezers contain floor insulation \geq R-28
 - Display cases
 - Lighting: time switches or motion sensors
 - Low temp defrost
 - Anti-sweat heater control based on relative humidity

** Not all inclusive. Site-built units have identical requirements covered in C403.2.16*

Refrigeration Systems: *Section C403.5*

▶ **New code section**

- **Fan-powered condenser requirements**
 - Saturated condensing temperatures
 - Condenser fan motors < 1 hp: Electrically-Commutated Motor, Permanent Split Capacitor or 3-phase motor
 - Variable speed approach
 - Multiple fans controlled in unison
 - Minimum condensing temperature setpoint < 70°F
- **Compressors**
 - Floating suction pressure control logic (with exceptions)
 - Liquid sub-cooling for low-temp systems
 - Crankcase heater cycling must be enabled

Proposed 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 large 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 \geq 1 Million Btu/h**
 - Thermal efficiency \geq 90%
- ▶ **Multiple pieces w/combined input rating \geq 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 considered part of building SWH 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 a heated-water supply pipe back to a heated-water source through cold-water supply pipe must be a demand recirculation water system**
- ▶ **Pumps to have controls that**
 - **Start pump upon receiving signal from action of user of fixture or sensing the 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**

Proposed 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 a 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
- ▶ 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

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 Control Function / Warehouses

Section C405.2.1.1

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

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 $\leq 15\%$

Daylight-responsive Controls: *Section C405.2.3 - Cont'd.*

- ▶ Capable of complete shutoff of all controlled lights
- ▶ Sidelight daylight zones facing different cardinal orientations (within 45 degrees of due north, east, south, west) controlled independently of each other

Exception

- ▶ < 150 watts in each space permitted to be controlled together with lighting in a daylight zone facing a different cardinal orientation

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

- ▶ LPD's 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)

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

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*

CBES – For More Information

Barry Murphy
EM&V Program Manager
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

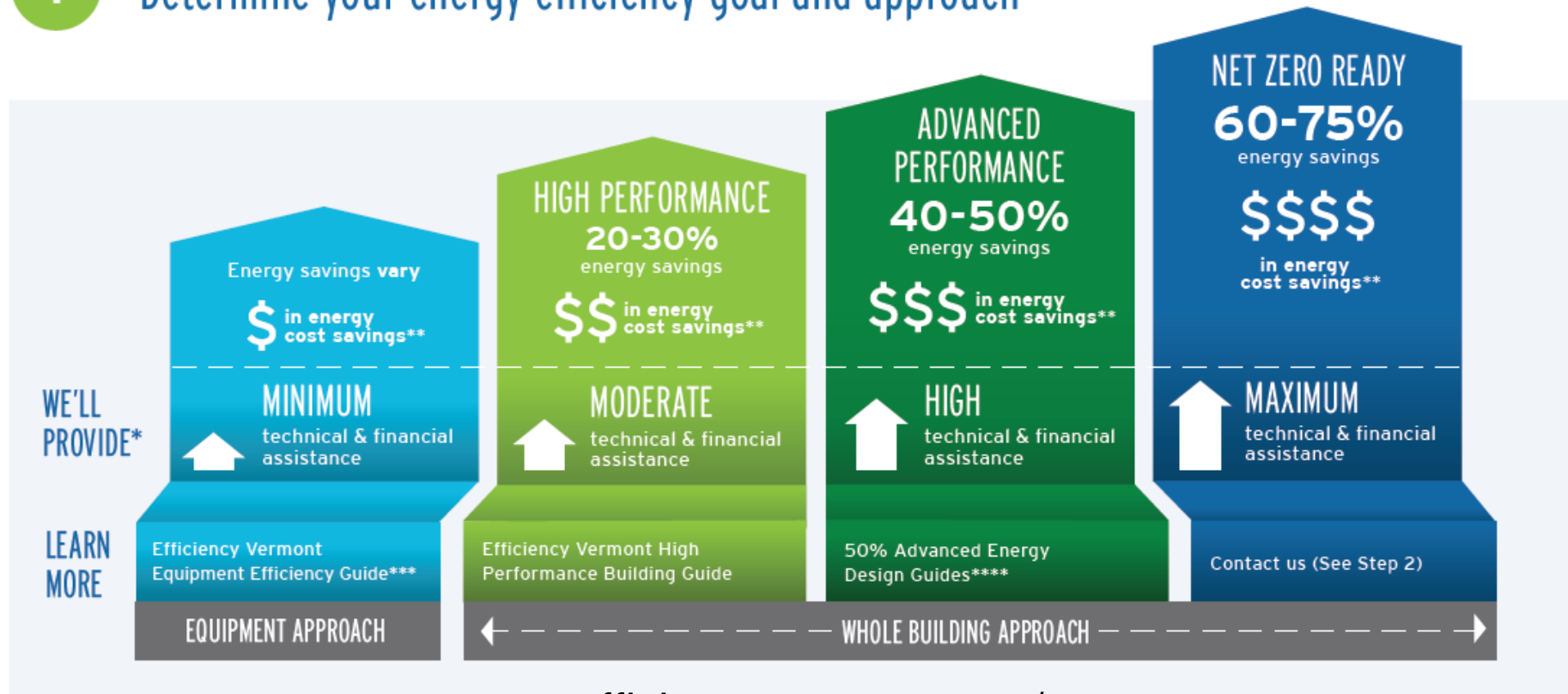
<https://www.encyvermont.com/For-My-Business/Ways-To-Save-and-Rebates/New-Construction-Major-Renovation>

Nick Thiltgen

Better Buildings by Design
Burlington, VT
February 4th, 2015

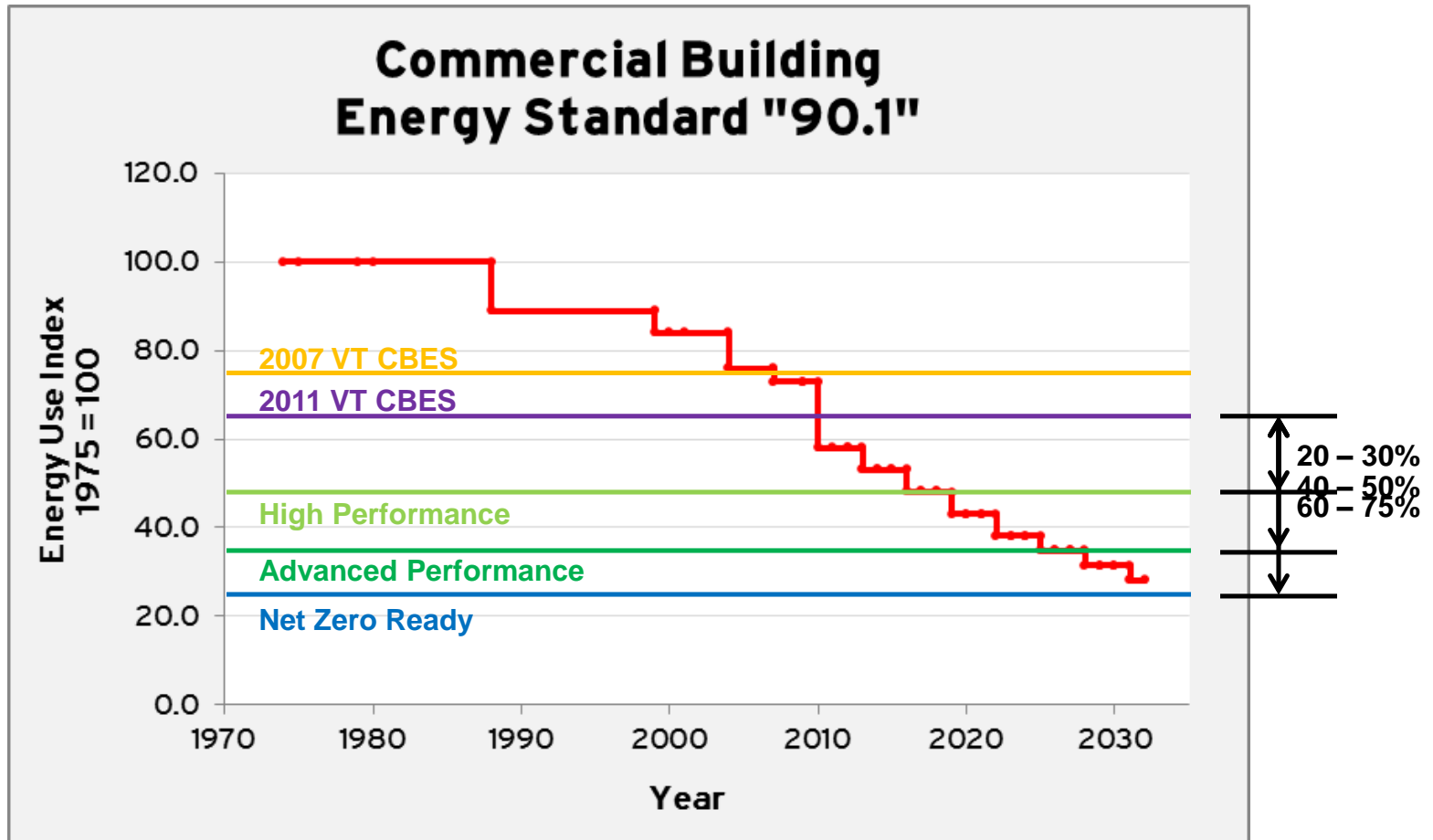
EFFICIENCY VERMONT - PROGRAM

1 Determine your energy efficiency goal and approach

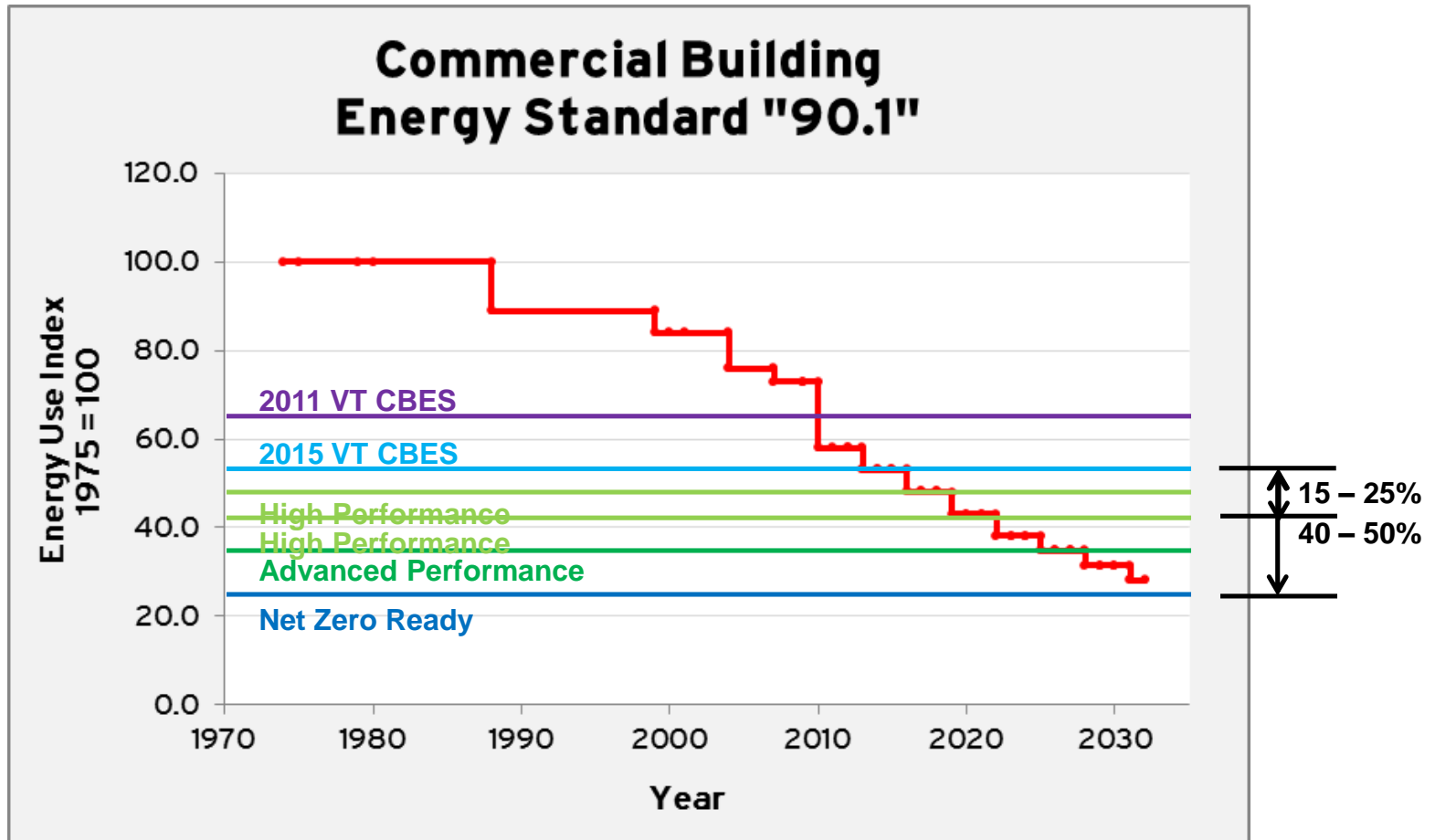


www.encyvermont.com/cnc

EFFICIENCY VERMONT - PROGRAM



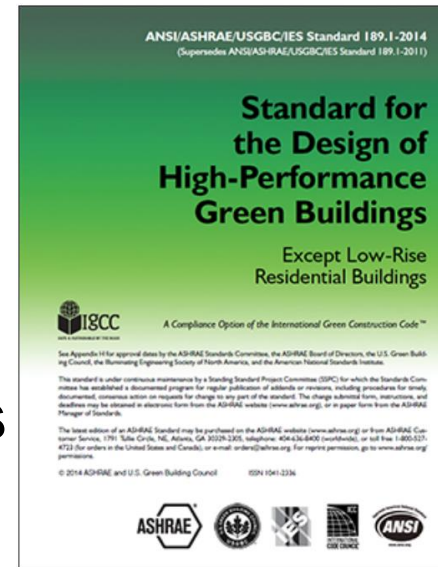
EFFICIENCY VERMONT - PROGRAM



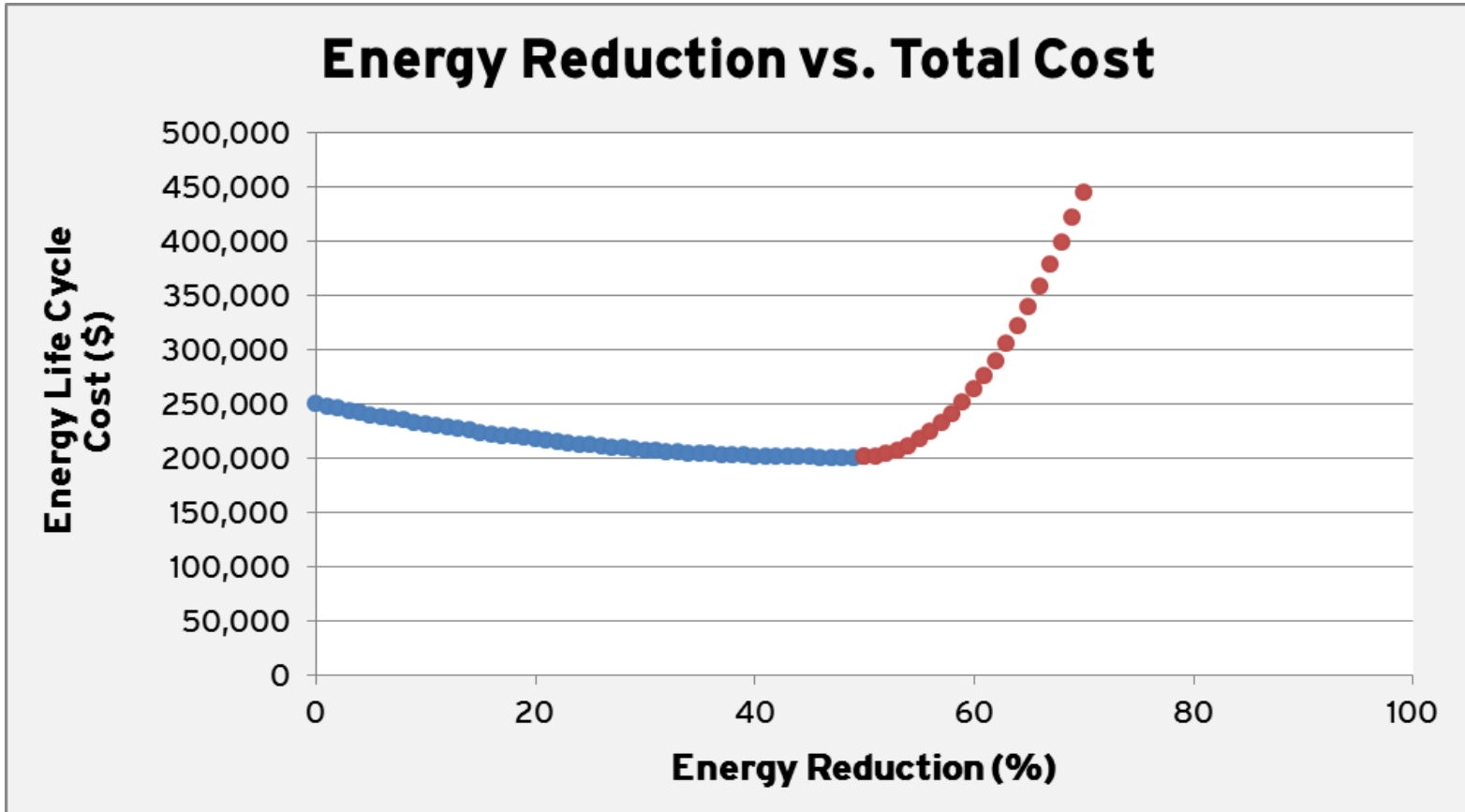
EFFICIENCY VERMONT - PROGRAM

Efficiency Measures

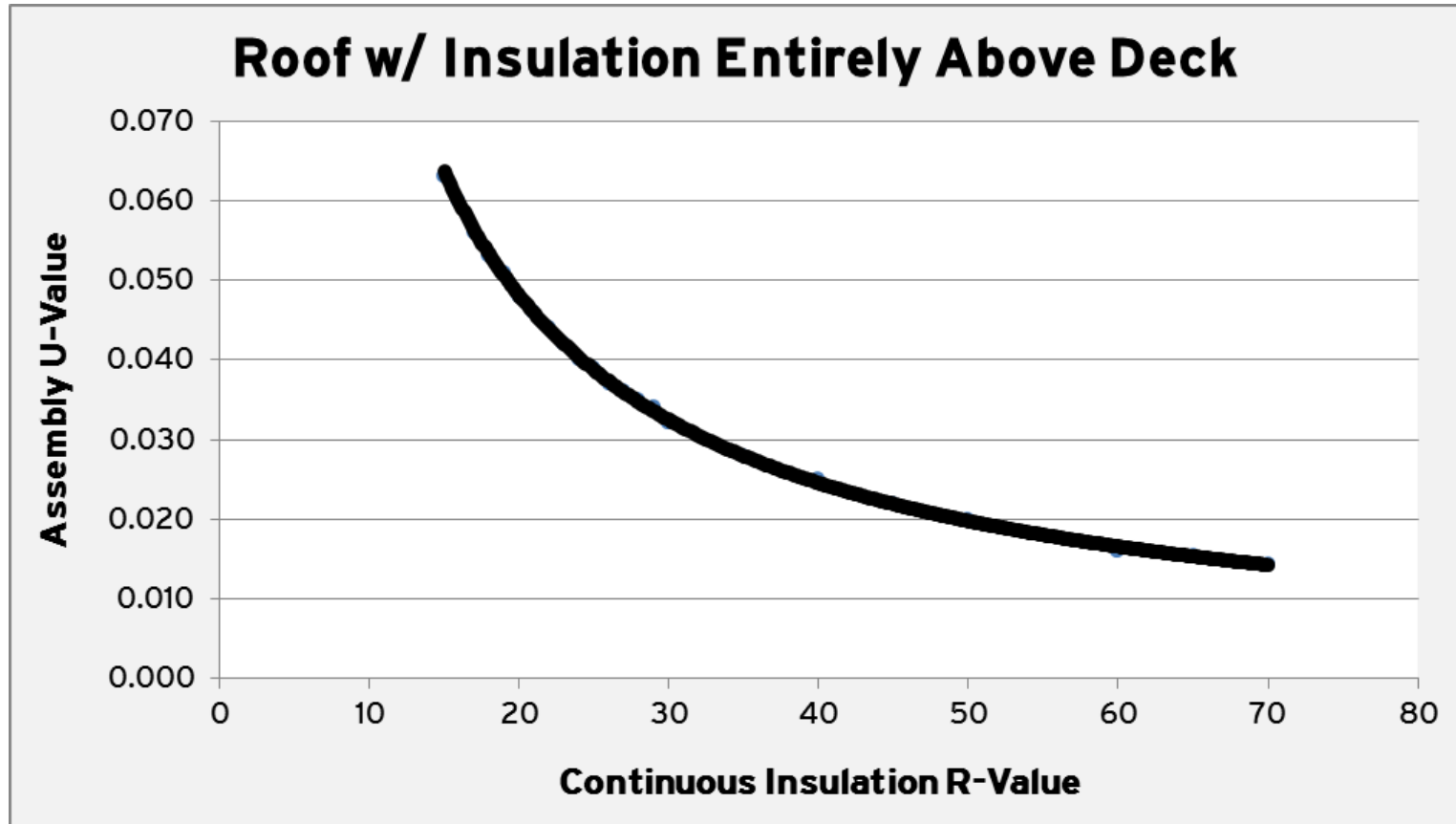
- Building Envelope Insulation & Air Sealing
- Exterior & Interior Lighting Power
- HVAC Equipment Efficiency
- Domestic Water Heater Efficiency & Fixtures
- Building Specific Equipment
- Energy Monitoring
- Building Commissioning



EFFICIENCY VERMONT - PROGRAM



EFFICIENCY VERMONT - PROGRAM



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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

