VERMONT

DEPARTMENT OF PUBLIC SERVICE

Vermont Codes Update Stakeholder Meetings

July 25 & 26, 2018
White River Junction and Burlington, VT

http://publicservice.vermont.gov/content/building-energy-standards-update

ENERGY FUTURES GROUP

Cx associates LLC

NAVIGANT

nbi new buildings institute

Code Update: Who

- Public Service Department, Planning and Energy Resource Division
  - Kelly Launder: Assistant Director
  - Keith Levenson: Energy Program Specialist
  - Barry Murphy: Evaluation, Measurement and Verification Program Manager
- Energy Futures Group (EFG)
  - Role: Project Management and Residential Lead
  - Who: Richard Faesy, Gabrielle Stebbins, Emily Bergan
- Navigant Consulting
  - Role: Commercial Code:
    - Envelope and Envelope Trade-off Option, Electrical Power, Lighting
  - Who: Keith Downes, Stu Slote
- Cx Associates
  - Role: Commercial Code:
    - Mechanical Systems, Service Water, Commissioning, Existing Buildings
  - Who: Jen Chiodo, Eveline Killian
- New Buildings Institute
  - Role: Roadmap, stretch code, national expertise
  - Who: Eric Makela, Jim Edelson

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Presentation Overview

1. Introduction
2. Setting the Stage
3. Roadmap to Net-Zero by 2030
4. Commercial Code – Potential Updates
5. Q&A

This presentation and the recording of it will be posted on the PSD website:

http://publicservice.vermont.gov/content/building-energy-standards-update

VERMONT
DEPARTMENT OF PUBLIC SERVICE

» Introduction

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Update: Why

- **30 V.S.A. § 53. (Commercial Building Energy Standards)**
  - "At least every three years after January 1, 2011, the commissioner of public service shall amend and update the CBES by means of administrative rules adopted in accordance with 3 V.S.A. chapter 25. The commissioner shall ensure that appropriate revisions are made promptly after the issuance of updated standards for commercial construction under the IECC or ASHRAE/ANSI/IESNA standard 90.1, whichever provides the greatest level of energy savings."

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Update: Framework

Multiple statutory requirements and policy goals pertaining to energy in Vermont:

- 10 V.S.A. § 581 (building efficiency goals)
- 10 V.S.A. § 578 (greenhouse gas reduction)
- 30 V.S.A. § 8002-8005 (Renewable Energy Standard)
  - Additional net-metering (mostly solar)
  - Tier Three (requirement to shift from fossil fuels to electricity)
- Comprehensive Energy Plan (all new buildings designed to net zero by 2030)
- And more…resolutions and agreements regarding electric vehicles, limiting emissions, etc.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

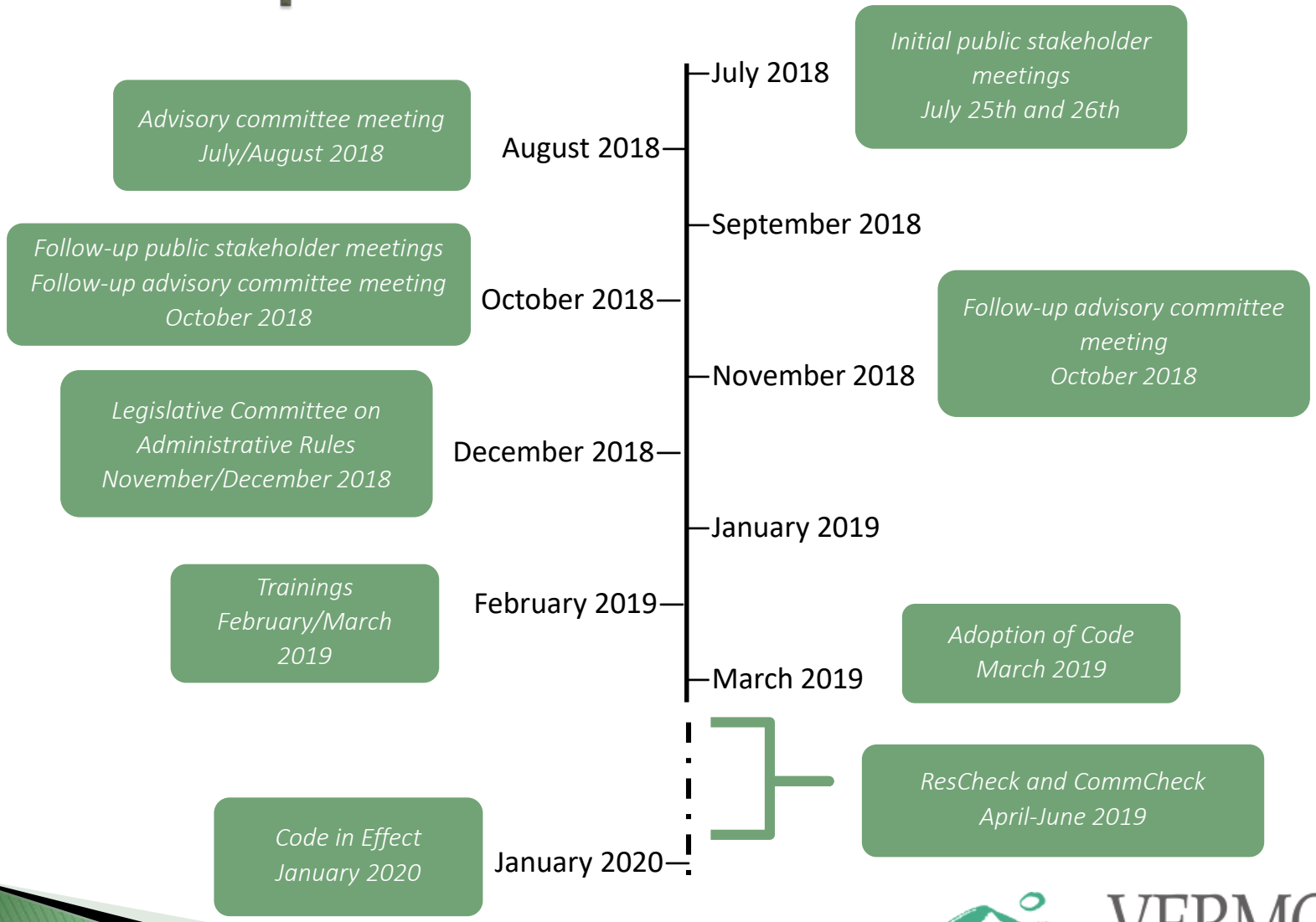
Code Update: *New* Framework

These requirements and goals suggest a new framework for building energy code into 2030 (net zero is *not* being proposed for *this* code update)

- Roadmap approach to new construction design to net zero by 2030
- Shift towards efficient electric heating
- Shift towards incorporating renewables ("solar ready") and electric vehicle charging capabilities
- But still need to recognize federal pre-emption requirements that states can't require higher standards than federal

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Update: Schedule



VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Update: Advisory Committee

- Required by statute
- Technically-focused to do “deep dive” into code language
- Representation from:
  - Energy efficiency utilities
  - Architects
  - Builders
  - ASHRAE
  - Log Home Representative
  - Affordable Housing Representative
  - Insulators
  - State officials
  - Regional energy advocates
  - Trade associations (renewables, fuel dealers, building performance professionals)

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Update: Opportunity for Input

The information presented today has not been decided upon; it is meant to initiate discussion

- Stakeholder meetings
  - July 25 – Hartford
  - July 26 – Burlington
- Advisory Committee meeting
  - August 2
- Follow up stakeholder meetings
  - October
- Follow up Advisory Committee meeting
  - October
- Opportunity for written comments throughout process

VERMONT
DEPARTMENT OF PUBLIC SERVICE

»Setting the Stage

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Update Process Scope

The code update process scope is focused on updating code language. It will not address issues such as enforcement.

Interested in addressing these issues?

1. Coordinate with one another
2. Decide on an approach to addressing these issues
3. Speak to your legislators

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Compliance Plan Progress

- 2012 Study: "Vermont Energy Code Compliance Plan – Achieving 90% Compliance by 2017"
- Progress to date:
  - Municipal coordination and support (Act 89 of 2013 and Efficiency Vermont "Municipal Guide")
  - Ongoing coordination between Public Service Department and Department of Public Safety
  - Act 250 requires stretch code compliance
  - Efficiency Vermont provides code trainings and support
  - Builder licensing/registration efforts considered
  - Some lenders and closing attorneys require

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Market Baseline Studies

Commercial

- 2011 CBES compliance rate: 92%
- 2015 CBES compliance rate: 90%
  - Respondents reported that 66% of projects undertaken exceed the minimum CBES requirement

VERMONT
DEPARTMENT OF PUBLIC SERVICE

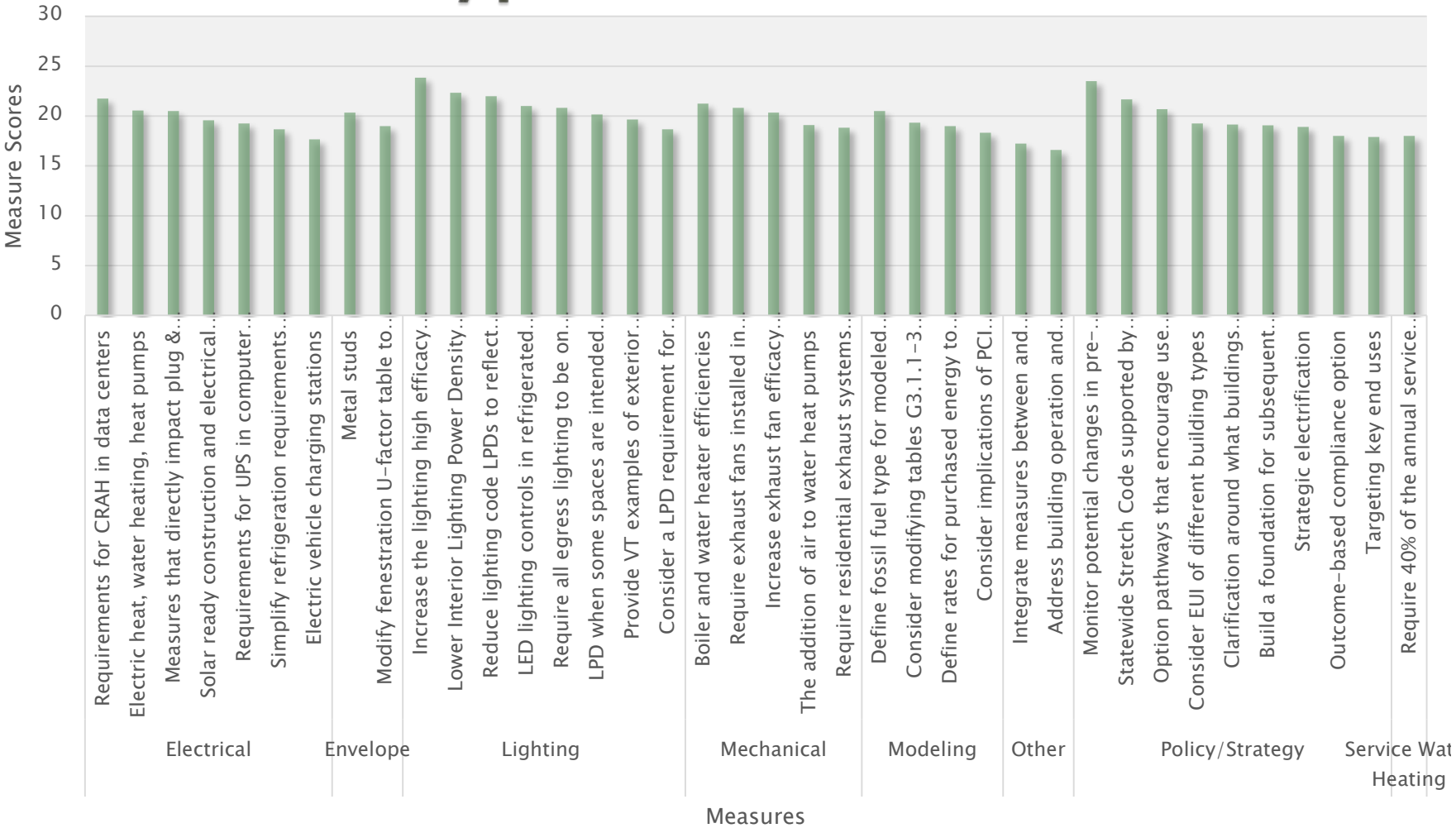
Scoring of Potential Measures

- Process
  - Developed list of measures as a scoping exercise (prior to research)
  - Developed scoring approach
  - PSD, energy efficiency utilities and Advisory Committee invitees were requested to review

- Results
  - All measures were considered important…so our presentation today shows a broad range of measures

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Commercial Measure Scores by Measure Type



VERMONT
DEPARTMENT OF PUBLIC SERVICE

Proposed Code Basis

- Commercial
  1. Starting with IECC 2018
  2. Adding in 2015 CBES
  3. After stakeholder and Advisory Committee process, adding in changes to reach 2019 CBES

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Roadmap to Net-Zero by 2030

nbi new buildings institute

Roadmap to Net-Zero

Comprehensive Energy Plan (2011)

- Net-Zero Buildings Recommendation:

  "Consider and address the potential challenges for net-zero buildings in Vermont and complete recommendations for a clear path to achieve a goal of having <u>all new buildings built to net-zero design by 2030</u>. These recommendations will include the mechanisms that must be instituted to achieve such a goal (such as regulatory codes, energy codes, financing and incentives, and workforce training)."

Renewable Energy Standard "Tier Three"

- Reduce fossil fuel usage; heat pumps; electric vehicles…

nbi new buildings institute

Other states are moving in this direction

Multiple states are moving in this direction

- NY, MA, WA, OR, CA

The New York Times

California Will Require Solar Power for New Homes

Solar panels on a Southern California home. State law requires at least 50 percent of California's electricity to come from noncarbon-producing sources by 2030. David Paul Morris/Bloomberg

By Ivan Penn

May 9, 2018

SACRAMENTO — Long a leader and trendsetter in its clean-energy goals, California took a giant step on Wednesday, becoming the first state to require all new homes to have solar power.

- State officials and clean-energy advocates say the extra cost to home buyers will be more than made up in lower energy bills. That prospect has won over even the construction industry, which has embraced solar capability as a selling point.
- Under the new requirements, builders must take one of two steps: make individual homes available with solar panels, or build a shared solar-power system serving a group of homes.
- For residential homeowners, based on a 30-year mortgage, the Energy Commission estimates that the standards will add about $40 to an average monthly payment, but save consumers $80 on monthly heating, cooling and lighting bills.
- It requires new homes to have a solar-power system of a minimum 2 to 3 kilowatts, depending mostly on the size of the home.

nbi new buildings institute

What is a Zero Energy Building?

A Zero Energy (ZE) building* is highly energy efficiency and meets ≥100% of its annual energy from renewables.

- ***Energy*** *= All energy (electric, gas, steam, liquid fuel etc.) consumed on site*
- ***Net*** *= One year or more of on-site renewable energy production minus energy use*
- ***Verified*** *= A year of more of documented performance at net zero*
- ***Emerging*** *= not yet a year or more of data (may be on a path to ZE)*
- ***EUI*** *= Energy Use Intensity in kBtu/sf/yr - metric of energy performance.*

Marin Country Day School (Photo: Michael David Rose)

**Also known as Net Zero Energy (NZE), or Zero Net Energy (ZNE). Zero Energy Building (ZEB)*

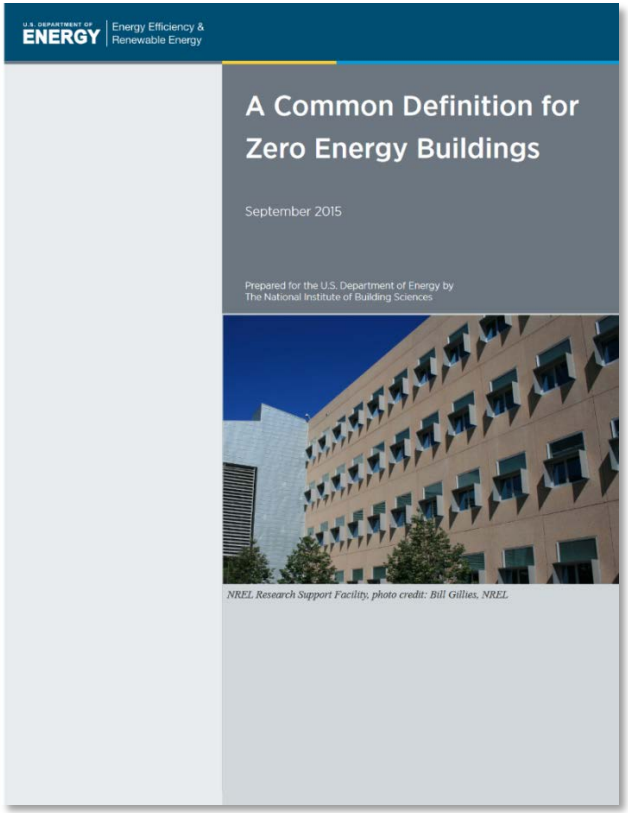
nbi new buildings institute

Zero Energy Definitions

DOE released A Common Definition for Zero Energy Buildings in September 2015: A Zero Energy Building (ZEB) is an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

CA DGS State Administrative Manual (SAM) Section 1815.31 ZNE Definition: Energy Efficient building that produces as much clean renewable energy as it consumes over the course of a year, when accounted for at the energy generation source. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all fuel extraction, transmission, delivery, and production losses. By taking all energy use into account, the ZNE definition provides a complete assessment of energy used in buildings.

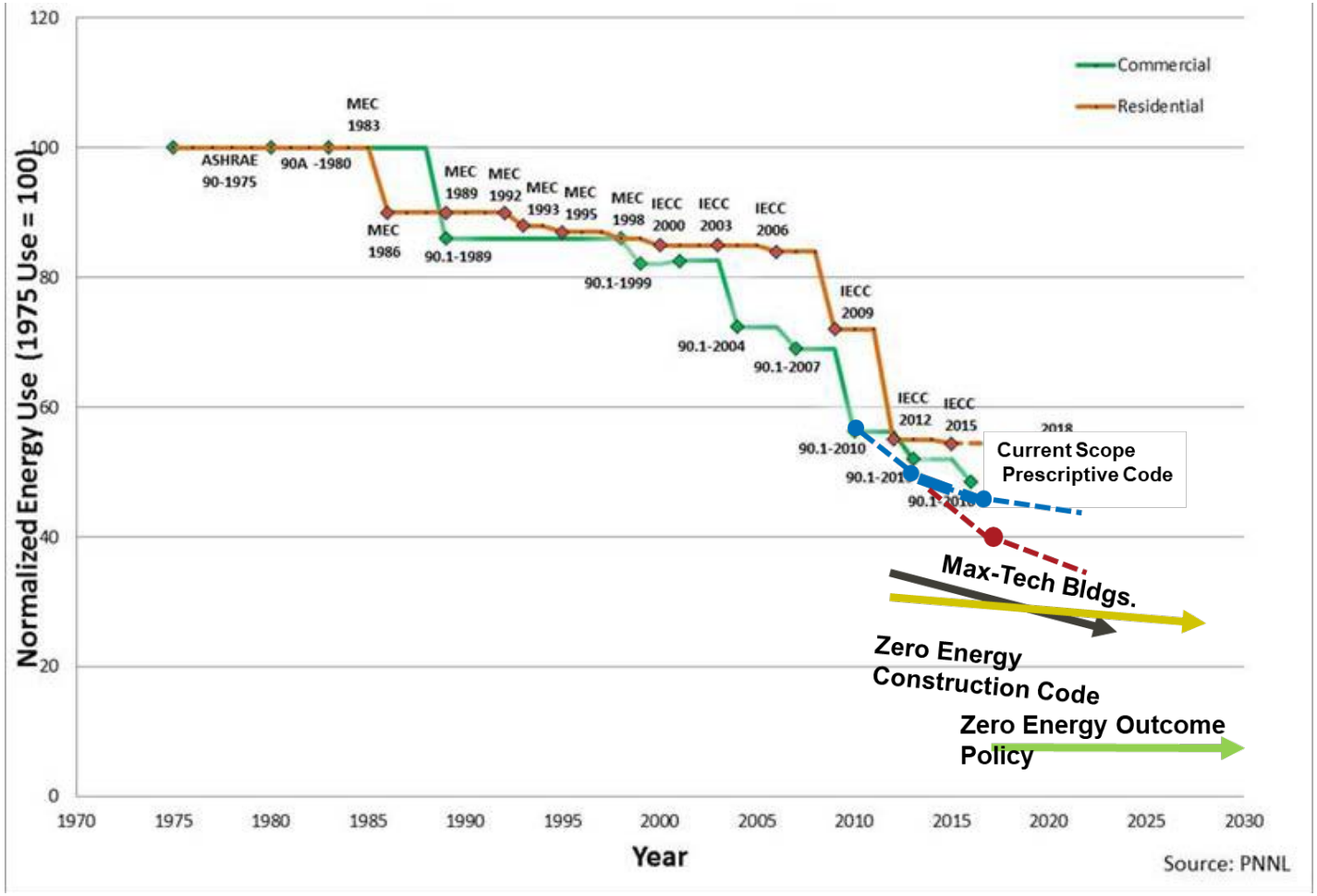
New Buildings Institute Definition: ZE buildings are ultra-low energy buildings that consume only as much power as is generated onsite through renewable energy resources over the course of a year.



Note: There *will* be a process to define "net zero" for Vermont (including biomass).

nbi new buildings institute

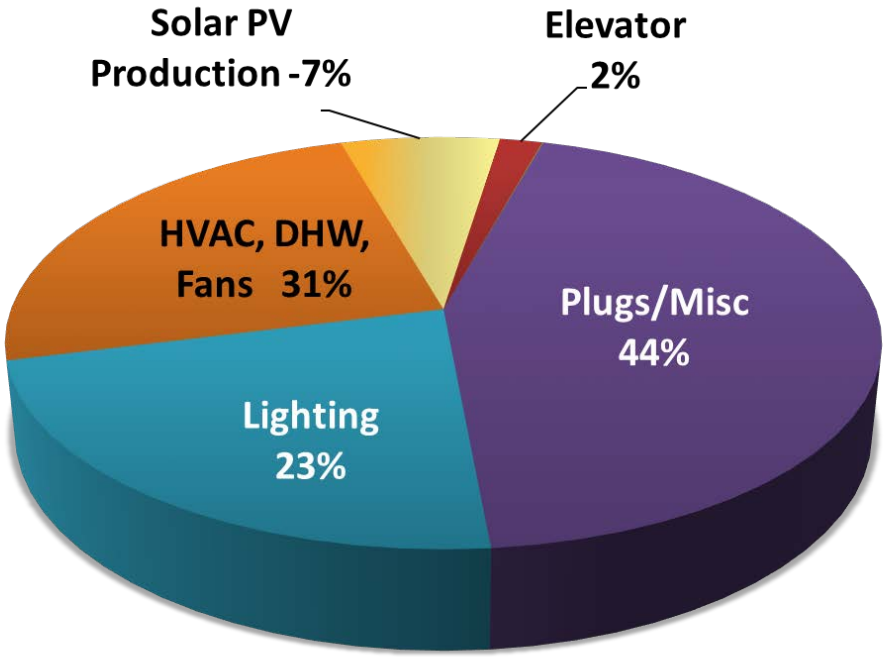
Improvement in Model Energy Codes



nbi new buildings institute

Opportunities for additional savings

RFM: Energy End Use based on 2 years



NET EUI = 20 kBtu/sf/yr

nbi new buildings institute

Vermont Energy Efficiency Standards for Appliances and Equipment (Act 139 of 2018)

- Air compressors.
- Commercial dishwashers.
- Commercial fryers.
- Commercial hot-food holding cabinets.
- Commercial steam cookers.
- Computers and computer monitors.
- Faucets.
- High CRI fluorescent lamps.
- Portable air conditioners.
- Portable electric spas.
- Residential ventilating fans.
- Showerheads.
- Spray sprinkler bodies.
- Uninterruptible power supplies
- Urinals
- Water coolers.

nbi new buildings institute

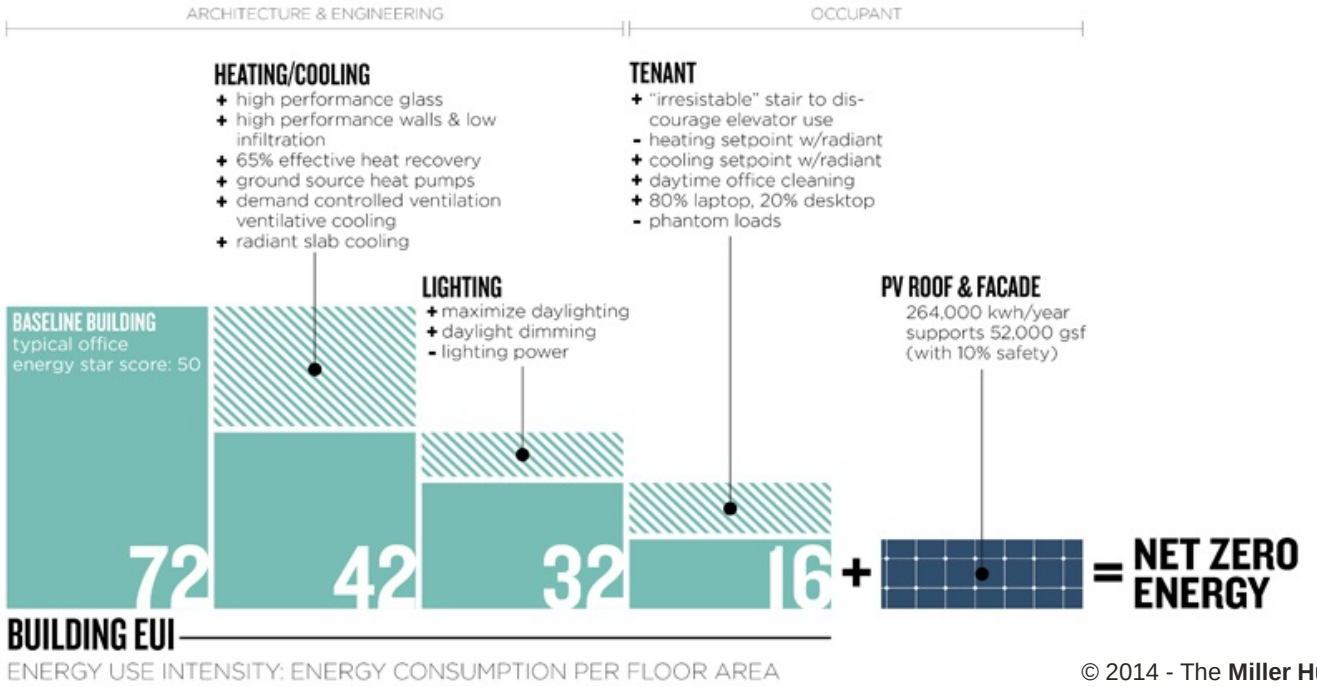
Potential Approach to Roadmap: Step 1: Establish the EUI Target

- Set absolute energy targets instead of simply “% better than code”
- Couple with other sustainability goals and policies (LEED, etc.)
- Consider existing facility benchmarking results
- Determine solar capacity on roof and/or campus

nbi new buildings institute

Potential Approach to Roadmap: Step 2: Set Your Energy Target

- Begin by defining your energy target and solar budget



© 2014 - The **Miller Hull** Partnership, LLP

nbi new buildings institute

Examples of Zero Energy Targets

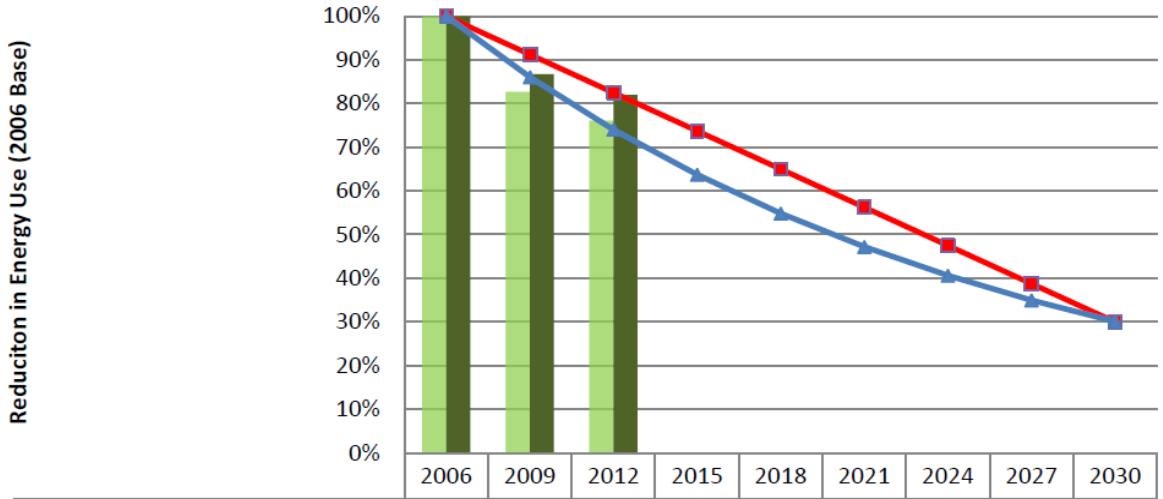
Table 3-1 Target EUI

Climate Zone	Site Energy		Source Energy	
	Primary School EUI, kBtu/ft^2·yr	Secondary School EUI, kBtu/ft^2·yr	Primary School EUI, kBtu/ft^2·yr	Secondary School EUI, kBtu/ft^2·yr
0A	22.5	22.9	69.1	70.5
0B	23.1	23.2	71.4	71.6
1A	21.3	21.1	65.5	65.0
1B	21.7	21.6	66.6	66.6
2A	20.9	21.3	63.8	65.1
2B	19.6	19.9	59.7	60.8
3A	18.8	19.1	56.7	57.7
3B	19.0	19.4	57.3	58.8
3C	17.5	17.6	52.6	52.8
4A	18.8	18.9	56.3	56.7
4B	18.4	18.5	55.1	55.5
4C	17.5	17.6	51.9	52.3
5A	19.2	19.1	57.1	56.9
5B	18.7	19.0	55.6	56.6
5C	17.4	17.6	49.7	52.3
6A	21.1	20.6	62.8	61.2
6B	19.5	19.5	57.9	57.9
7	22.3	21.5	66.2	63.7
8	25.2	23.8	71.1	70.7

ASHRAE Achieving Zero Energy Design Guide for K-12 Schools

nbi new buildings institute

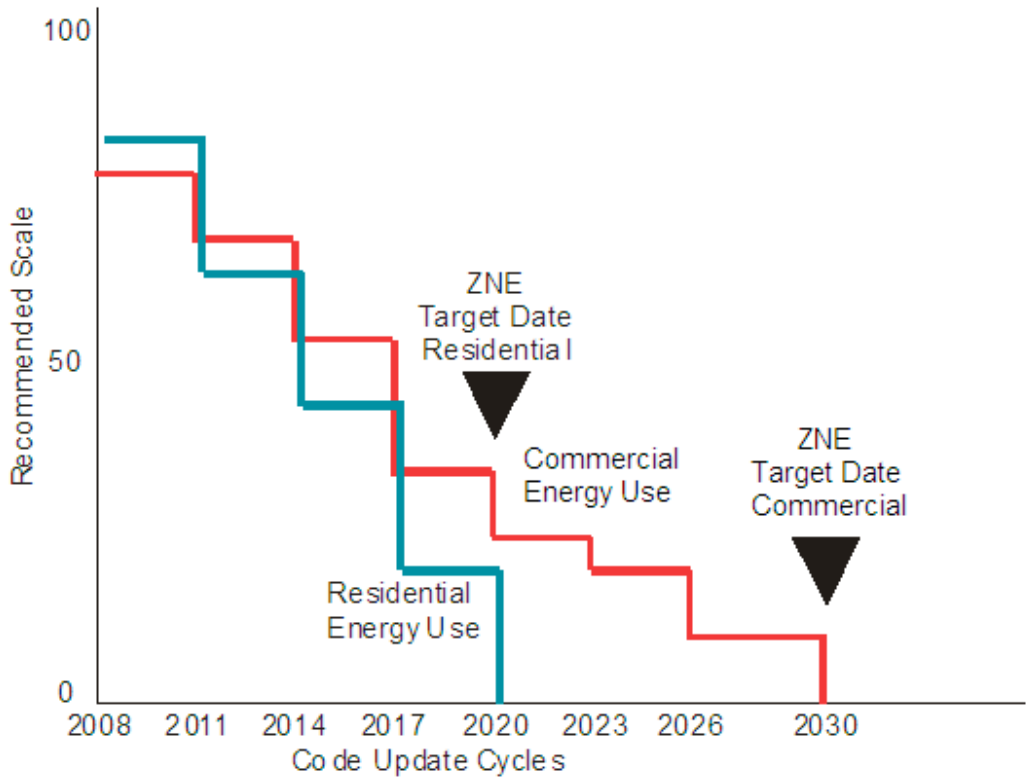
WA Code Improvement Targets



	2006	2009	2012	2015	2018	2021	2024	2027	2030
Residential	100%	82.7%	76.1%						
Commercial	100%	86.8%	82.0%						
Target: 8.75 % savings compared to the 2006 WSEC	100%	91%	83%	74%	65%	56%	48%	39%	30%
Target: 14% savings compared to each previous code	100%	86%	74%	64%	55%	47%	41%	35%	30%

nbi new buildings institute

CA Title 24 – The First ZNE Roadmap



nbi new buildings institute

CA Title 24-2019

Target EDRS for different scenarios in different climate zones for the 2,700 s.f. mixed fuel homes

1	2	3	4	5	6	7	8	9	10	11
CZ	Efficiency EDR without PV, based on 2019 Efficiency Measures	Target Design Rating Score for Displacing kWh Elect with PV from Col 4	Solo PV Sized to Displace Annual kWh Electric – Cool with NEM, not so Cool with GH	Solo PV Sized to Zero EDR – Violates NEM, Not Cool with GH	PV Size for Zero EDR with Basic Battery Controls – May Violate NEM, OK with GH	PV Size for Zero EDR with Optimum Battery Controls – Cool with NEM and GH	Similar to Col 7 But With 95 Furn, 0.95 WH – Real Cool with NEM and GH	Col 6 to 4 Ratio	Col 7 to 4 Ratio	Col 8 to 4 Ratio
1	48.0	26.5	3.4	7.7	6.9	4.6	4.1	2.0	1.4	1.2
2	41.2	18.0	2.9	6.1	5.5	3.1	2.8	1.9	1.1	1.0
3	46.9	22.7	2.8	5.8	5.3	3.2	2.9	1.9	1.1	1.0
6	48.0	20.9	2.9	5.3	4.5	2.9	2.8	1.6	1.0	1.0
7	48.0	14.9	2.7	4.6	3.9	2.4	2.3	1.4	0.9	0.9
8	43.0	14.6	2.9	5.3	4.3	2.7	2.6	1.5	0.9	0.9
11	43.3	23.4	3.8	8.5	6.5	4.4	4.2	1.7	1.2	1.1
12	43.1	24.5	3.1	7.0	5.8	3.8	3.5	1.9	1.2	1.1
13	44.8	22.1	4.0	9.0	6.2	4.9	4.6	1.6	1.2	1.2
14	44.6	21.3	3.4	7.4	5.4	4.4	4.1	1.6	1.3	1.2
15	48.0	17.9	5.7	10.5	8.1	6.9	6.8	1.4	1.2	1.2
16	46.3	27.5	3.0	7.6	6.5	4.8	4.3	2.2	1.6	1.4

nbi new buildings institute

Data Sources For Potential Vermont Targets

Data Sources:

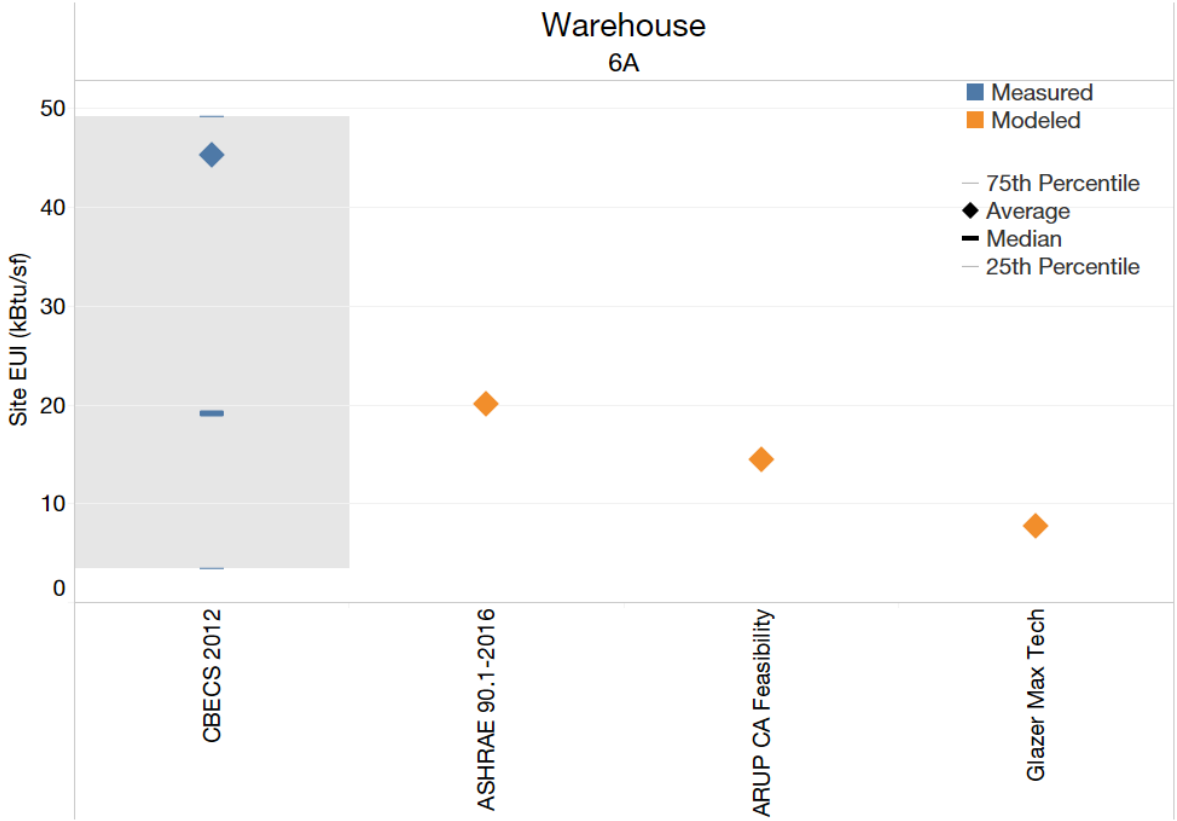
Label	Source	Description
90.1-2016	PNNL Modeling Data for 90.1-2016	Prototype modeling
CBECS 2012	CBECS 2012	Commercial building stock performance
GTZ Tracker	NBI Getting to Zero Tracker	Existing zero energy building performance
Standard 100	ASHRAE Standard 100	ASHRAE Standard 100 energy targets
NREL School Feasibility	NREL - School Technical Feasibility	Maximum achievable energy performance study
ARUP CA Feasibility	ARUP - California Technical Feasibility	Maximum achievable energy performance study
Glazer Max Tech	GARD Analytics - Max Tech Potential	Maximum achievable energy performance study
Toronto	Toronto Zero Emissions Framework	Toronto zero energy performance targets
HERS	Residential Energy Services Network (RESNET)	High performance single family building sample

Building Type Information:

Building Type	CBECS 2012	Building Models	GTZ Tracker
Medium Office	10k-100k sf	53,600 sf, 3 floors	10k-100k sf
Medical Office	All sizes	N/A	N/A
Primary School	All sizes	73,960 sf, 1 floor	All Sizes
Secondary School	All sizes	210,900 sf, 2 floors	All Sizes
Mid-rise Multifamily	N/A	33,600 sf, 4 floors	All Sizes
High-rise Multifamily	N/A	84,360 sf, 10 floors	N/A
Warehouse	All Sizes	49,495 sf, 1 floor	N/A
Large Hotel	N/A	122,132 sf, 7 floors	N/A
Standalone Retail	All Sizes	25,000 sf, 1 floor	N/A

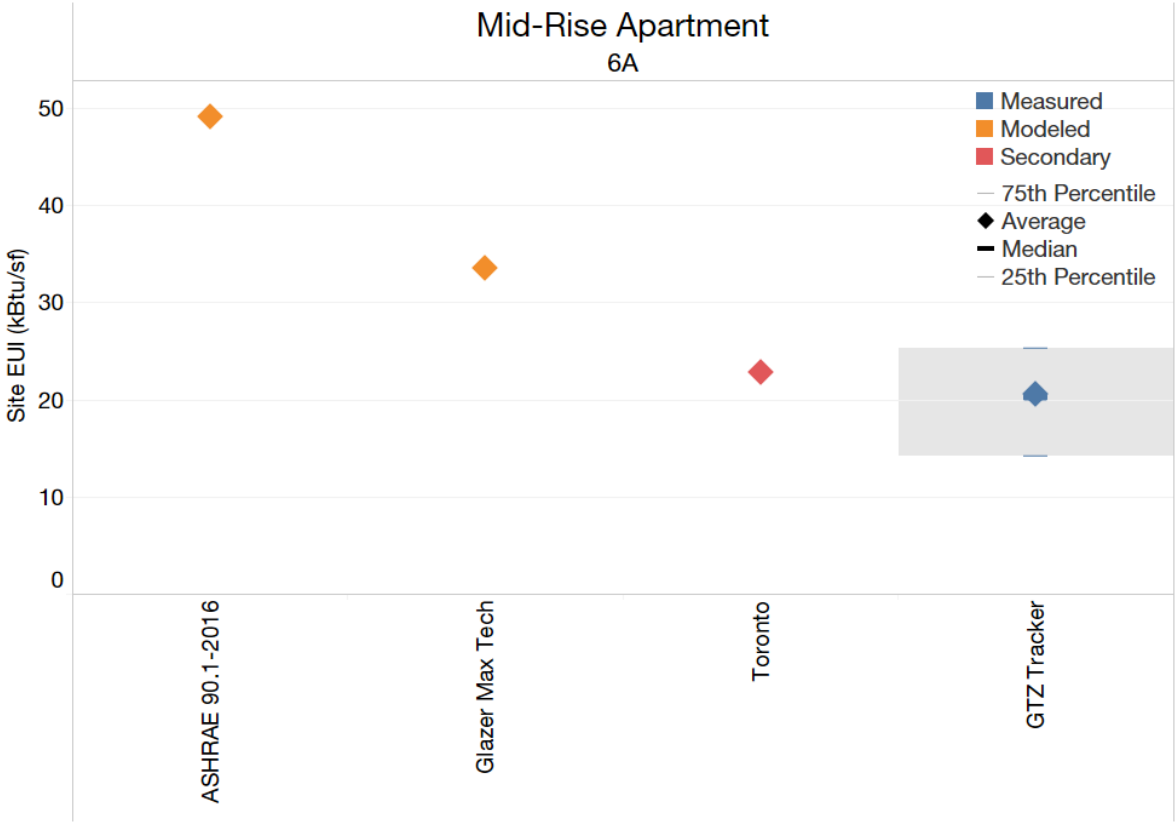
nbi new buildings institute

Trends in Modeled EUIs vs. Measured Data



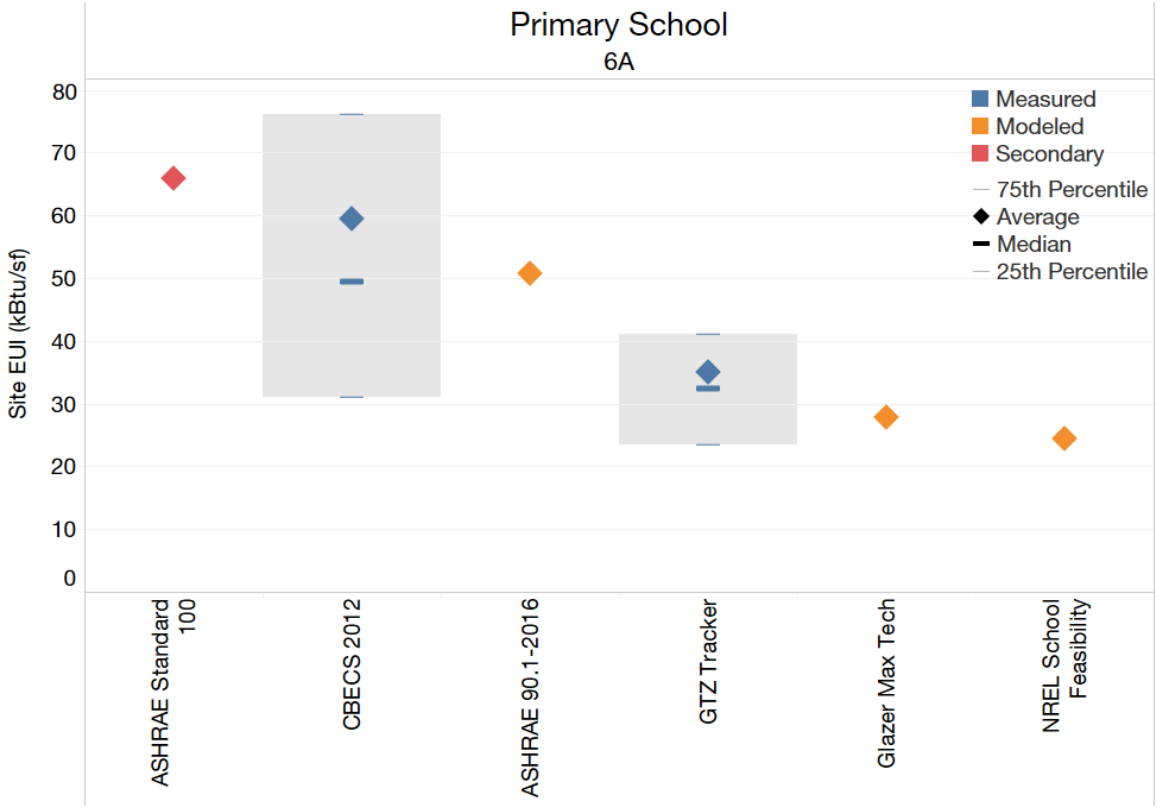
nbi new buildings institute

Trends in Modeled EUIs vs. Measured Data Mid-Rise Apartment



nbi new buildings institute

Trends in Modeled EUIs vs. Measured Data Primary School

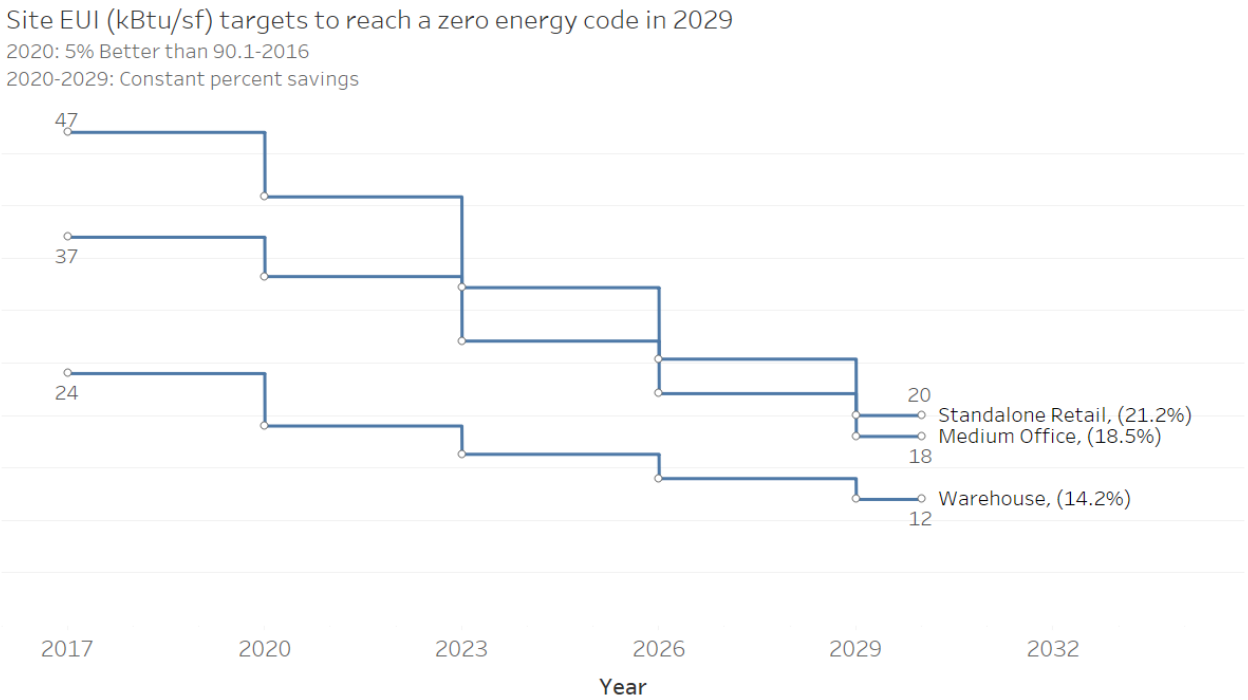


nbi new buildings institute

Trends in Modeled EUIs vs. Measured Data Stand Alone Retail

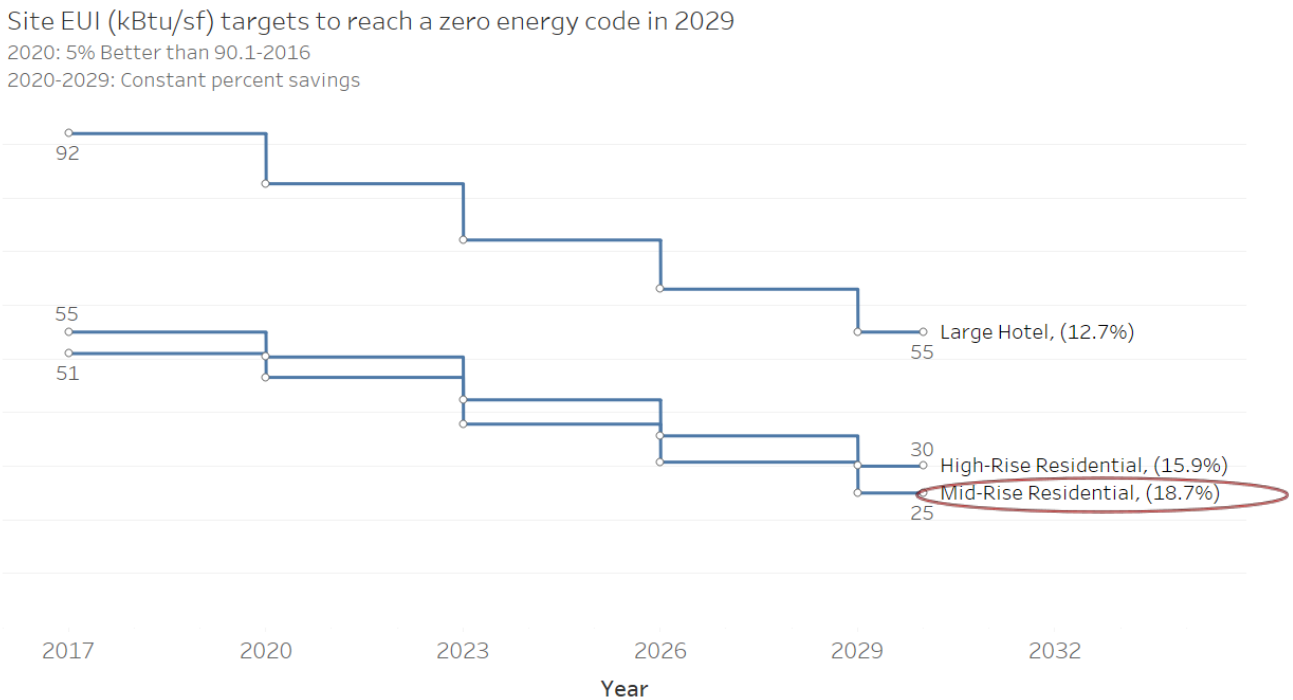
nbi new buildings institute

For discussion:
Site EUI targets to reach a ZE code in 2029: Retail, Office, Warehouse



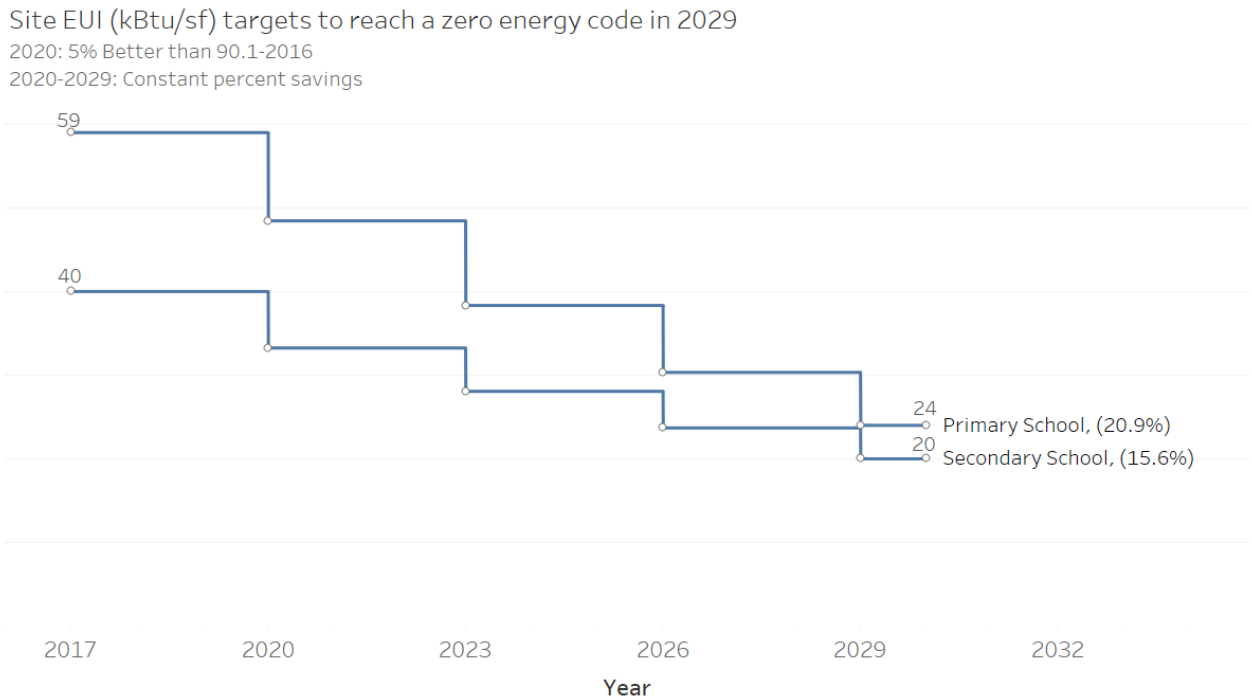
nbi new buildings institute

For discussion:
Site EUI targets to reach a ZE code in 2029: Mid-Rise Residential



nbi new buildings institute

For discussion: Site EUI targets to reach a ZE code in 2029: Schools



nbi new buildings institute

Potential Target Code Performance Levels

	Constant Percent Savings							
Year	Mid-Rise Residential	High-Rise Residential	Large Hotel	Primary School	Secondary School	Medium Office	Standalone Retail	Warehouse
2017	51.0	55.0	92.0	59.0	40.0	37.0	47.0	24.0
2020	46.6	50.4	82.7	48.5	33.3	33.3	40.9	19.0
2023	37.8	42.4	72.2	38.3	28.1	27.1	32.2	16.3
2026	30.8	35.7	63.0	30.3	23.7	22.1	25.4	14.0
2029	25.0	30.0	55.0	24.0	20.0	18.0	20.0	12.0
2020-2029 per cycle Savings (%)	**18.7%**	**15.9%**	**12.7%**	**20.9%**	**15.6%**	**18.5%**	**21.2%**	**14.2%**

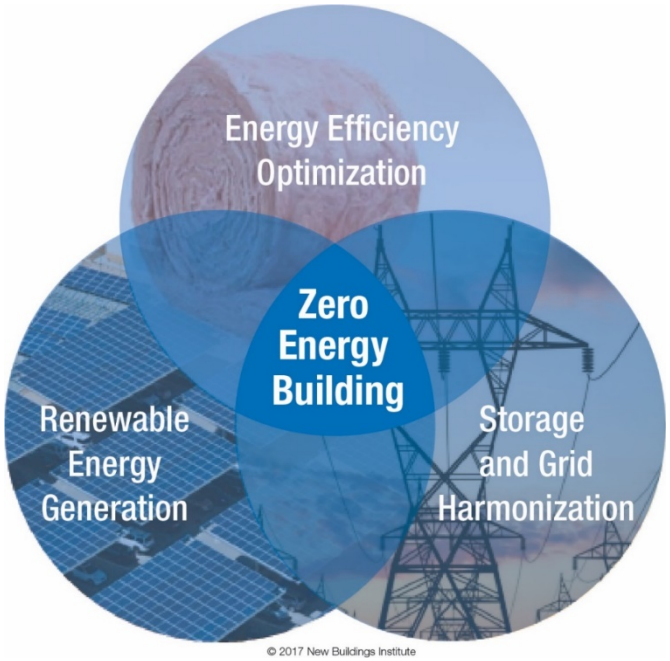
nbi new buildings institute

Code Landscape

- Prescriptive Codes
- Modeling Compliance Path
- Zero Energy Design Codes
- Zero Energy Outcome Policy
- Zero Carbon Codes

nbi new buildings institute

Complimentary Elements in ZNE



nbi new buildings institute

» Commercial

Presentation Overview & Schedule

- Summary and Performance Cost Index (10 minutes)
- Building Envelope (25 minutes)
- Mechanical and Service Water Heating (45 minutes)
- Electric Power and Lighting Systems (40 minutes)
- Additional Efficiency Package Options, Commissioning and Existing Buildings (20 minutes)

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Summary of Changes

- 2018 IECC commercial: Total of 129 approved proposals
  - Section 4 (mechanical) completely reorganized
  - 36 proposals increase energy efficiency, 3 major
  - 10 proposals reduce energy efficiency, 2 major
- Vermont Modifications to 2018 IECC
  - Carry forward of Vermont modifications in 2015 CBES
  - 42 proposed Vermont specific modifications
  - 19 proposals increase energy efficiency, 6 major
- ASHRAE 90.1-2016 : Total of 121 addenda
  - Major format changes for ease of use
  - New climate maps aligning with ASHRAE Standard 169
  - New performance-based compliance path
  - 49 of the 121 addenda have energy impact

Source: IECC and ASHRAE summary from Pacific Northwest National Laboratory

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Compliance Approach

Current Approach	Proposed Approach	Required Documents
2015 CBES	2019 CBES	CBES Certificate and COMcheck
ASHRAE 90.1 – 2013 with Amendments	ASHRAE 90.1 – 2016 Sections 5-10 with Amendments	CBES Certificate and COMcheck
ASHRAE 90.1 – 2013 Energy Cost Budget Method	ASHRAE 90.1 – 2016 Section 11 – Energy Cost Budget Method	CBES Certificate and all documentation as noted in Section 11.1.5 of ASHRAE 90.1-2016
	ASHRAE 90.1 – 2016 Appendix G – Performance Rating Method	CBES Certificate and all documentation as noted in Appendix G of ASHRAE 90.1-2016
Above-Code Program Prescriptive		Contact Vermont DPS for approval of above-code program

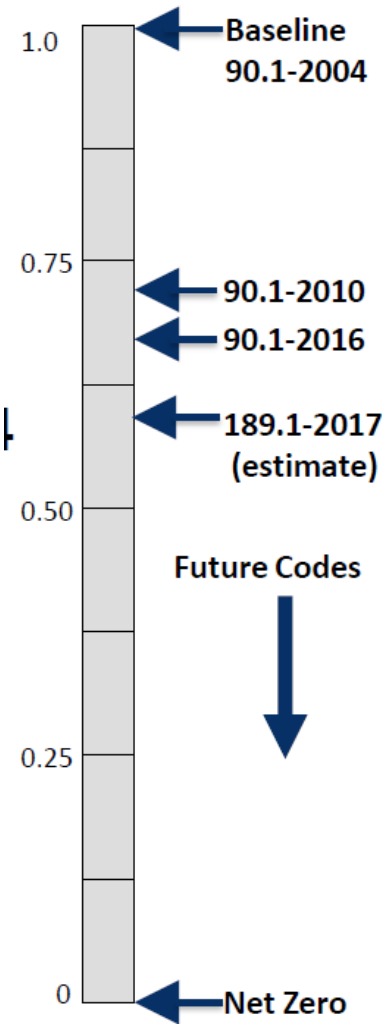
VERMONT
DEPARTMENT OF PUBLIC SERVICE

New Compliance Path

- 90.1-2016 Introduces a Third Path for Compliance
- Appendix G requires a Performance Cost Index (PCI) specific to building type and climate zone

$$Performance\ Cost\ Index\ (PCI) = \frac{Proposed\ Building\ Performance}{Baseline\ Building\ Performance}$$

- Stable and independent baseline set ~ 90.1-2004
- Intent is that the stringency of the baseline doesn't change (stable)
- Clear rules about what systems and other prescriptive choices are in baseline (independent)
- PCI target changes with each version of a code
- Each code edition has a required PCI for compliance
- Beyond code programs can choose a PCI to meet their needs
  - Vermont will base PCI on building modeling of the prescriptive CBES compliance path



Source: Pacific Northwest National Laboratory

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Performance Cost Index

The Performance Cost Index (PCI) shall be modified in 2019 CBES as follows

- PCI shall be fuel neutral
  - PCI = (BPF * BBEC)/BBP, where
    - BPF = Building Performance Factor
    - BBEC = Baseline Building Energy Cost
    - BBP = Baseline Building Performance
- BPF shall be modified to reflect typical 2019 CBES performance as determined by modeling
- Stretch guidelines shall have stretch BPF factors as determined by modeling

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Changes
C402
Building Envelope

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Summary of Major Changes: Building Envelope

- R-Values / U-factors aligned with 2015 CBES Stretch Guidelines
- Increased fenestration requirements
- Air leakage compliance via testing reduced to 0.40 CFM/SF
- Construction documents must include air barrier information
- Air leakage tests for dwelling units
- Air barrier commissioning

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Building Envelope – *Table C402.1*

Component	2015 Minimum R-Values		Proposed 2019 Minimum R-Values	
	All other	Group R	All other	Group R
Roofs				
Insulation entirely above roof deck	R-30ci		R-35ci	
Metal buildings	R-25 + R-11 LS		R-30 + R-11 LS	
Walls, Above grade				
Mass	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci
Metal-framed	R-13 + R-7.5ci or R-13ci		R-13 + R-12.5ci or R18ci	
Floors				
Mass	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Fenestration – *Table C402.3*

Component	2015 Vertical fenestration	Proposed 2019 Vertical fenestration
U-factor		
Fixed fenestration	0.36	0.29
Operable fenestration	0.43	0.37
Entrance doors	0.77	0.68
Skylights		
U-Factor	0.5	0.48
SHGC	0.4	0.38

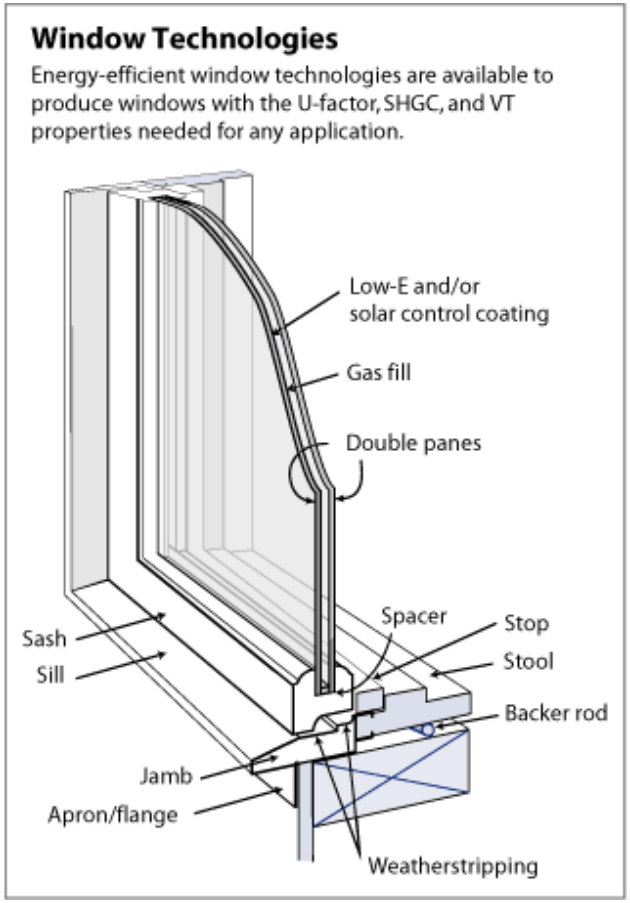


Image Source: Pacific Northwest National Laboratory, Heat, R.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Air Leakage Compliance via Testing

Tested air leakage rate of the building thermal envelope is not greater than ~~0.50~~ 0.40 cfm/per square foot of shell area (excluding area of slab and below grade walls) at 50 Pa.

But there is an exemption if you fail to achieve 0.40 CFM/SF

Where the measured air leakage rate exceeds 0.40 cfm/ft2 but does not exceed 0.60 cfm/ft2, a diagnostic evaluation, such as a smoke tracer or infrared imaging shall be conducted while the building is pressurized, and any leaks noted shall be sealed if such sealing can be made without destruction of existing building components.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Construction Documents Must Include Air Barrier

Construction documents shall contain a diagram showing the building's pressure boundary in plan(s) and section(s) and a calculation of the area of the pressure boundary to be considered in the test.

Image Source: Canadian Timber Frames LTD

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Air Leakage Tests for Dwelling Units

A sampling of dwelling units shall be tested and the air leakage rate of each tested dwelling unit's enclosure surface area shall not exceed 0.40 cfm/ft2 of surface area. …The sampling of dwelling units tested shall include at least 20 percent of the dwelling units in each building, including at least one of each unit type … and approximately an equal number of units on each floor level. Each of these units must be tested and pass without a failure. If a failure occurs, items causing the failure must be diagnosed, and corrected, and the unit retested until it passes. A minimum of at least two additional units of this type in the same building must also be tested and pass.

Image Source: The Energy Conservatory

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Air Barrier Commissioning

Prior to the final inspection, the registered design professional shall provide evidence of commissioning of the continuous air barrier by an approved agency. A final commissioning report shall be delivered to the building owner, and shall include at a minimum:

1. A field inspection checklist showing the requirements necessary for proper installation of the continuous air barrier.

2. Reports from field inspections during project construction showing compliance with continuous air barrier requirements including but not limited to proper material handling and storage, use of approved materials and approved substitutes, proper material and surface preparation, air barrier continuity at building thermal envelope penetrations

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Changes
C402
Building Envelope

Stretch Guidelines

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Stretch Guidelines: Definitions & Envelope

- Redefine residential buildings
- Increased building envelope requirements
- Energy efficient fireplaces

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Redefine Residential Buildings

RESIDENTIAL BUILDING. For this code, includes detached one- and two-family dwellings and multiple single- family dwellings (townhouses) as well as Group R-2, R-3 and R-4 (see Occupancy Classifications) buildings three stories or less in height above grade plane. Additionally, Group R-2 buildings cannot have more than 19 dwelling or sleeping units to be considered a residential building. Group R-2 buildings with 20 or more dwelling or sleeping units are commercial buildings.

- R-1 = Occupancies containing sleeping units where the occupants are primarily transient in nature, e.g. hotels/motels
- R-2 = Occupancies containing sleeping units or more than two dwelling units where the occupants are primarily permanent in nature, e.g. apartment houses, dormitories, fraternities/sororities, vacation timeshare
- R-3 = Occupancies where the occupants are primarily permanent in nature and not classified as Group R-1, R-2, R-4, or I, e.g. care facilities with <= 5 persons receiving care
- R-4 = Buildings for > 5, but <= 16 persons, excluding staff, who reside on a 24-hour basis in a supervised residential environment and receive custodial care, e.g. assisted living facilities, halfway houses

Building Envelope – *Table C402.1*

Component	Proposed 2018 Base Code R-Values		Proposed 2019 Stretch Code R-Values	
	All other	Group R	All other	Group R
Walls, Above grade				
Mass	R-15.2ci	R-15.2ci	R-20ci	R-20ci
Wood-framed and other	R-13 + R7.5ci or R-19 + R-5ci or R-15ci		R13 + R-15.6ci or R20 +R10 ci or R-18ci	
Slab-on-grade floors				
Unheated Slabs	R-10ci	R-15ci	R-15ci	R-20
Heated Slabs	R-15	R-20	R-20	R-20

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Energy Efficient Fireplaces

All solid fuel-burning appliances and fireplaces shall meet the provisions of this section.

1. *Gasketed doors.* - All solid fuel-burning appliances and fireplaces shall have tight-fitting … metal glass or ceramic doors.
2. *Spillage testing.* - All chimney-vented equipment shall establish complete draft without spillage under “worst-case” conditions within two minutes.
3. *Exterior air supply requirements.*- Shall be equipped with an exterior air supply.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Changes
C403
Building Mechanical Systems

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Summary of Major Changes: Mechanical Systems

- Supplemental electric resistance heat is allowed on cold-climate heat pump systems with proper control and enhanced envelope (blower door required)
- Proper equipment sizing
- Increased equipment efficiencies
- VFDs required on smaller hydronic systems and motors
- Economizers requirements expanded
- Required hotel/motel guestroom HVAC occupancy control
- Stipulated protection of exterior piping insulation
- Vestibule heat controls
- HVAC Automatic Start/Stop required

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Building Mechanical Systems

- Cold-climate heat pumps may have supplemental electric resistance heat with controls that:
  - Prevent supplementary heater operation when the heating load can be met by the heat pump alone; and
  - In which the cut-on temperature for compression heating is higher than the cut-on temperature for supplementary heating, and the cut-off temperature for compression heating is higher than the cut-off temperature for supplementary heating; and
  - In buildings with 0.25CFM/sf air barrier efficiency. Blower door testing would be required.

- Electric resistance prohibition has not changed
  - See list of exceptions, Section C403.1.2

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Equipment sizing

C403.2.2

- The output capacity of heating and cooling equipment shall be not greater than the loads calculated in accordance with Section C403.2.1. 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 ten percent greater than the calculated peak heating and cooling loads to allow for building pickup and cool down after temperature setback conditions. A single piece of equipment providing both heating and cooling greater than 10 tons shall have variable capacity control. Hot gas bypass variable capacity control is prohibited.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Mechanical Efficiencies: *Table 403.2.x*

TABLE C403.2.3(3)
MINIMUM EFFICIENCY REQUIREMENTS:
ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS,
PACKAGED TERMINAL HEAT PUMPS, SINGLE-PACKAGE VERTICAL AIR CONDITIONERS,
SINGLE VERTICAL HEAT PUMPS, ROOM AIR CONDITIONERS AND ROOM AIR-CONDITIONER HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY
Room air conditioners, with louvered sides	< 6,000 Btu/h	—	~~9.7~~ 11 CEER
	³ 6,000 Btu/h and < 8,000 Btu/h	—	~~9.7~~ 11 CEER
	³ 8,000 Btu/h and < 14,000 Btu/h	—	~~9.8~~ 10.9 CEER
	³ 14,000 Btu/h and < 20,000 Btu/h	—	~~9.7~~ 10.7 CEER
	³ 20,000 Btu/h and ≤ 25,000 Btu/h	—	~~8.5~~ 9.4 CEER
	³ 25,000 Btu/h		9.0 CEER
Room air conditioners, without louvered sides	< 6,000 Btu/h		10.0 CEER
	³ 6,000 Btu/h and < 8,000 Btu/h	—	~~9.0~~ 10.0 CEER
	³ 8,000 Btu/h and < 11,000 Btu/h	—	~~8.5~~ 9.6 CEER
	³ 11,000 Btu/h and < 14,000 Btu/h	—	~~8.5~~ 9.5 CEER
	³ 14,000 Btu/h and < 20,000 Btu/h		9.3 CEER
	³ 20,000 Btu/h		9.4 CEER
Room air-conditioner heat pumps with louvered sides	< 20,000 Btu/h	—	9.8 CEER
	³ 20,000 Btu/h	—	~~8.5~~ 9.3 CEER
Room air-conditioner heat pumps without louvered sides	< 14,000 Btu/h	—	~~8.5~~ 9.3 CEER
	³ 14,000 Btu/h	—	8.7 CEER

MONT
DEPARTMENT OF PUBLIC SERVICE

Mechanical Efficiencies: *Table 403.2.x*

TABLE 403.2.3(4)
WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES AND UNIT HEATERS, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY
Warm-air furnaces, gas fired	< 225,000 Btu/h	—	~~78%~~ 80% AFUE or 80%Etc
	³ 225,000 Btu/h	Maximum capacityc	80%Etf
Warm-air furnaces, oil fired	< 225,000 Btu/h	—	~~78%~~ 83% AFUE or 80%Etc
	³ 225,000 Btu/h	Maximum capacityb	81%Etg

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Mechanical Efficiencies: *Table 403.2.x*

TABLE C403.2.3(5)
MINIMUM EFFICIENCY REQUIREMENTS: GAS- AND OIL-FIRED BOILERS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	MINIMUM EFFICIENCY
Boilers, hot water	Gas-fired	< 300,000 Btu/h	~~80%~~ 82% AFUE
		³ 300,000 Btu/h and £ 2,500,000 Btu/hb	80% Et
		> 2,500,000 Btu/ha	82% Ec
	Oil-firedc	< 300,000 Btu/h	~~80%~~ 84% AFUE
		³300,000 Btu/h and £ 2,500,000 Btu/hb	82% Et
		> 2,500,000 Btu/ha	84% Ec
Boilers, steam	Gas-fired	< 300,000 Btu/h	~~75%~~ 80% AFUE
	Gas-fired- all, except natural draft	³ 300,000 Btu/h and £ 2,500,000 Btu/hb	79% Et
		> 2,500,000 Btu/ha	79% Et
	Gas-fired-natural draft	³ 300,000 Btu/h and £ 2,500,000 Btu/hb	77% Et
		> 2,500,000 Btu/ha	77% Et
	Oil-firedc	< 300,000 Btu/h	~~80%~~ 82% AFUE
		³ 300,000 Btu/h and £ 2,500,000 Btu/hb	81% Et
		> 2,500,000 Btu/ha	81% Et

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Fan Efficiency: *Section C403.2.*

- C403.2.12.2 Motor nameplate horsepower.
  - Motor nameplate horsepower shall not exceed 1.1 times BHP
- Fractional horsepower fan motors 1/12HP–1HP motors shall use ECMs.
- C403.2.12.3 Fan efficiencies for sizes above 1HP shall meet section C403.8.3
  - Existing code has this standard for motors > 5HP

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Pump Controls C403.4.2.4

- Automatically vary pump flow on heating-water systems, chilled-water systems and heat rejection loops serving water-cooled unitary air conditioners as follows:.1 Where pumps operate continuously or operate based on a time schedule, pumps with nominal output motor power of ~~5 hp~~ 2 hp or more shall have a variable speed drive.
-
  - Where pumps have automatic direct digital control configured to operate pumps only when zone heating or cooling is required, a variable speed drive shall be provided for pumps with motors having the same or greater nominal output power indicated in Table C403.4.4 based on the climate zone and system served.
- Where a variable speed drive is required, pump motor power input shall be not more than 30 percent of design wattage at 50 percent of the design water flow. Pump flow shall be controlled to maintain one control valve nearly wide open or to satisfy the minimum differential pressure.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Fan Speed Control

- **C403.4.3.1 Fan speed control.**
  Each fan system powered by an individual motor or array of motors with connected power, including the motor service factor, totaling ~~5 hp~~ 2 hp or more shall have controls and devices configured to automatically modulate the fan speed to control the leaving fluid temperature or condensing temperature and pressure of the heat rejection device. Fan motor power input shall be not more than 30 percent of design wattage or 50 percent of the design airflow.

- **C403.4.4 Heat rejection equipment fan speed control.**
  Each fan powered by a motor of ~~7.5 hp~~ 5 hp or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.
  - **Exception**: Factory-installed heat rejection devices within HVAC equipment tested and rated in accordance with Tables C403.2.3(6) and C403.2.3(7).

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Economizers

- **C403.3** Economizers shall comply with Sections C403.3.1 through C403.3.4. An air or water economizer shall be provided for the following cooling systems:
- Chilled water systems with a total cooling capacity, less cooling capacity provided with air economizers, as specified in Table C403.5(1).
- Individual fan systems with cooling capacity greater than or equal to 54,000 Btu/h (15.8 kW) in buildings having other than a Group R occupancy,
- The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 300,000 Btu/h (88 kW), whichever is greater.
- Individual fan systems with cooling capacity greater than or equal to 270,000 Btu/h (79.1 kW) in buildings having a Group R occupancy. The total supply capacity of all fan cooling units not provided with economizers shall not exceed 20 percent of the total supply capacity of all fan cooling units in the building or 1,500,000 Btu/h (440 kW), whichever is greater.
- All rooftop units.
- Note: computer room exclusion has been removed.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Economizer Fault Detection and Diagnostics: Section C403.2.4.7

- **Air cooled unitary direct-expansion units and variable refrigerant flow (VRF) units (≥ 15 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**

Unit size was ≥ 20 tons in CBES 2015

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Automatic HVAC Controls in Hotels/Motels > 30 Guestrooms

Each guestroom shall be provided with card key controls which comply with these requirements:

- **Automatic temperature setpoint controls**
  - Controls shall be provided on each HVAC system that are capable of and configured to automatically raise the cooling setpoint and lower the heating setpoint from the occupant setpoint within 30 minutes after the occupants have left the guestroom.
- **Ventilation controls**
  - Controls shall be provided on each HVAC system that are capable of and configured to automatically turn off the ventilation and exhaust fans within 30 minutes of the occupants leaving the guestroom, or isolation devices shall be provided to each guestroom that are capable of automatically shutting off the supply of outdoor air to and exhaust air from the guestroom.

Exterior Pipe Insulation Protection

Section C403.2.x

Piping insulation shall comply with both of the following requirements:

i. Insulation exposed to weather shall be suitable for outdoor service and shall be protected by aluminum, sheet metal, painted canvas, plastic cover, or other similar materials approved by the building official. Cellular foam insulation shall be protected as above or painted with a coating that is water-retardant and provides shielding from solar radiation; and

ii. Unless the insulation is vapor-retardant, insulation covering chilled-water piping or refrigerant suction piping located outside the conditioned space shall include a vapor retardant located outside the insulation. All penetrations and joints shall be sealed

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Heated Vestibules

- The heating system for heated vestibules and air curtains with integral heating shall be provided with controls configured to shut off the source of heating when the outdoor air temperature is greater than 45°F (7°C). Vestibule heating systems shall be controlled by a thermostat located in the vestibule configured to limit heating to a temperature not greater than 60°F (16°C). Cooling for vestibules is prohibited.

- **Exception**: Control of heating provided by site-recovered energy or transfer air that would otherwise be exhausted.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

HVAC System Automatic Start

Automatic start controls shall be provided for each HVAC system. The 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.

Code Changes
C403
Building Mechanical Systems

Stretch Guidelines

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Refrigeration Heat Recovery

HVAC systems shall utilize heat recovery from refrigeration system(s) for space heating, using no less than 25 percent of the sum of the design total heat of rejection of all refrigeration systems that have individual total heat of rejection values of 150,000 Btu/h or greater at design conditions.

- Exception: HVAC systems or refrigeration systems that are reused for an addition or alteration.

The increase in hydrofluorocarbon refrigerant charge associated with refrigeration heat recovery equipment and piping shall be no greater than 0.35 lbs per 1,000 Btu/h of heat recovery heating capacity

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Automatic Demand Shed Control

HVAC systems with DDC to the zone level shall be programmed to allow centralized demand shed for noncritical zones as follows:

- The controls shall have a capability to remotely set up the operating cooling temperature set points by four degrees or more in all noncritical zones on signal from a centralized contact or software point within an Energy Management Control System (EMCS).
- The controls shall have a capability to remotely set down the operating heating temperature set points by four degrees or more in all noncritical zones on signal from a centralized contact or software point within an EMCS.
- The controls shall have capabilities to remotely reset the temperatures in all noncritical zones to original operating levels on signal from a centralized contact or software point within an EMCS.
- The controls shall be programmed to provide an adjustable rate of change for the temperature setup and reset.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Changes
C404
Service Water Heating

Adopting language from
2018 IECC
No Major Changes

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Changes
C405
Electrical Power and Lighting Systems

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Summary of Major Changes: Electric & Lighting

- Open office area occupancy sensors
- Egress lighting controls
- Requirements added to daylight control functions
- Reduced lighting power allowance
- Renewable energy systems
- Electric vehicle charging stations

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Open Office Area Occupancy Sensors

Occupant sensor controls in open plan office spaces over 300 SF shall comply with all of the following:

1.The controls shall be configured so that general lighting can be controlled separately in control zones with floor areas not greater than 600 square feet (55 m2) within the open plan office space.

2.The controls shall automatically turn off general lighting in all control zones within 20 minutes after all occupants have left the open plan office space.

3.The controls shall be configured so that general lighting power in each control zone is reduced by not less than 80 percent of the full zone general lighting power in a reasonably uniform illumination pattern within 20 minutes of all occupants leaving that control zone.

4.The controls shall be configured such that any daylight responsive control will activate open plan office space general lighting or control zone general lighting only when occupancy for the same area is detected.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Egress Lighting Controls

Luminaires serving the exit access and providing means of egress illumination where the means of egress shall be illuminated at all times the room or space is occupied, including luminaires that function as both normal and emergency means of egress illumination shall be controlled by a combination of listed emergency relay and occupancy sensors, or signal from another building control system, that automatically reduces the lighting power by 50% when unoccupied for a period longer than 15 minutes.

Requirements Added to Daylight Control Functions

6. Incorporate time-delay circuits to prevent cycling of light level changes of less than three minutes.

7. The maximum area a single daylight responsive control device serves shall not exceed 2,500 square feet (232 m2).

8. Occupant override capability of daylight dimming controls is not permitted, other than a reduction of light output from the level established by the daylighting controls.

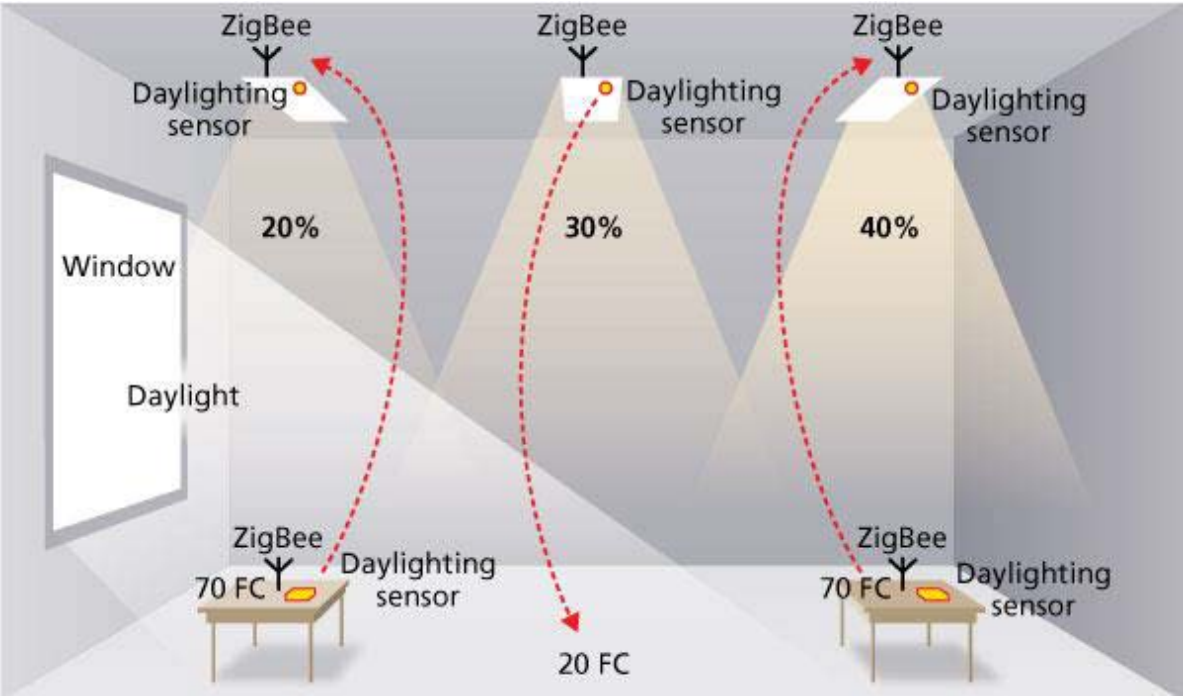


Image Source: Pacific Northwest National Laboratory, Heat, R.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Lighting Power Density – *Table C405.3.2(1)*

BUILDING AREA TYPE	LPD (w/ft2) 2015	LPD (w/ft2) 2019
Dining: cafeteria/fast food	0.90	0.79
Dining: family	0.95	0.78
Health care clinic	0.90	0.82
Hotel/Motel	0.87	0.75
Manufacturing facility	1.17	0.90
Office	0.82	0.79
Parking garage	0.21	0.15
Post office	0.87	0.67
Religious building	1.00	0.94
Retail	1.26	1.06
School/university	0.87	0.81
Town hall	0.89	0.80
Warehouse	0.60	0.48
Workshop	1.19	0.90

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Lighting Power Density – *Table C405.4.2(2)*

		LIGHTING ZONES 2015			LIGHTING ZONE 2018		
		Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3
Base Site Allowance		500 W	600 W	750 W	350 W	400 W	500 W
Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	Uncovered Parking Areas						
	Parking areas and drives	0.04 W/ft2	0.06 W/ft2	0.10 W/ft2	0.03 W/ft2	0.04 W/ft2	0.06 W/ft2
	Building Grounds						
	Walkways < 10 feet	0.7 W/linear foot	0.7 W/linear foot	0.8 W/linear foot	0.5 W/linear foot	0.5 W/linear foot	0.6 W/linear foot
	Walkways >= 10 feet wide	0.14 W/ft2	0.14 W/ft2	0.16 W/ft2	0.10 W/ft2	0.10 W/ft2	0.11 W/ft2
	Dining Areas	–	–	–	0.65 W/ft2	0.65 W/ft2	0.75 W/ft2
	Stairways	0.75 W/ft2	1.0 W/ft2	1.0 W/ft2	0.60 W/ft2	0.70 W/ft2	0.70 W/ft2
	Pedestrian tunnels	0.15 W/ft2	0.15 W/ft2	0.2 W/ft2	0.12 W/ft2	0.12 W/ft2	0.14 W/ft2
	Landscapin g	–	–	–	0.03 W/ft2	0.04 W/ft2	0.04 W/ft2

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Lighting Power Density – *Table C405.4.2(2)*

		LIGHTING ZONES 2015			LIGHTING ZONE 2018		
		Zone 1	Zone 2	Zone 3	Zone 1	Zone 2	Zone 3
Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas are tradable.)	**Sales Canopies**						
	Free-standing and attached	0.6 W/ft2	0.6 W/ft2	0.8 W/ft2	0.4 W/ft2	0.4 W/ft2	0.60 W/ft2
	Building Entrances and Exits						
	Main entries	20 W/linear foot of door width	20 W/linear foot of door width	30 W/linear foot of door width	14 W/linear foot of door width	14 W/linear foot of door width	21 W/linear foot of door width
	Other doors	20 W/linear foot of door width	20 W/linear foot of door width	20 W/linear foot of door width	14 W/linear foot of door width	14 W/linear foot of door width	14 W/linear foot of door width
	Entry canopies	0.25 W/ft2	0.25 W/ft2	0.4 W/ft2	0.20 W/ft2	0.25 W/ft2	0.4 W/ft2
	Loading Docks	-	-	-	0.35 W/ft2	0.35 W/ft2	0.35 W/ft2

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Renewable Energy Systems

Building projects with footprint greater than 20,000 square feet, shall install *on-site renewable energy* systems with a minimum rating of 3.7 W/ft2 or 13 Btu/h·ft2 (40 W/m2) multiplied by the horizontally-projected gross roof area. This system must meet a minimum of 6% of the projected energy use of the building for mechanical and service water heating and lighting or cover an area not to exceed 75% of gross roof area less the area covered by rooftop equipment, skylights, occupied roof decks and planted areas. This system can be ground mounted as long as all relevant permits are obtained.

If the building location, required orientation or design cannot accommodate the required on-site renewables then other options should be explored and proposed by the design team to the relevant authority.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Electric Vehicle Charging Stations

Parking spots shall have a socket capable of providing the required level 1 or level 2 charge (see Table C405.11) within 5 feet of the centerline of the parking space ("EV Charging Parking Space").

50% of the parking spaces, rounded up to the nearest whole number, shall have Electric Vehicle Supply Equipment (EVSE) or receptacles necessary to function as available electric vehicle charging upon building occupancy. The remainder shall be pre-wire to allow for installations at such time as they are needed for use by customers, employees or other users.

Facility Type	Minimum Number of Chargers (rounded up to nearest whole number)					
	<25		≥25 and <500		≥500	
	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2
Retail	0%	0%	2%	1%	1%	5
Hotel/Motel	4%	0%	2%	1%	1%	5
Restaurant	4%	4%	2%	2%	1%	5
Hospital/ Healthcare	4%	0%	2%	2%	1%	5
Office	4%	0%	4%	1%	2%	5
School/University	0%	0%	4%	2%	2%	5

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Changes
C405
Electric Power and Lighting Systems

Stretch Guidelines

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Stretch Guidelines: Electric & Lighting

- Parking garage lighting controls
- Dwelling unit lighting requirements
- Reduced interior lighting power allowance
- Requirement for fractional HP motors
- Control of electrical receptacles
- Solar rooftop readiness

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Requirements Added to Daylight Control Functions

Lighting for parking garages shall comply with the following requirements:

1. Parking garage lighting shall have *automatic* lighting shutoff.
2. Lighting power of each *luminaire* shall be automatically reduced by a minimum of 30% when there is no activity detected within a lighting zone for 20 minutes. Lighting zones for this requirement shall be no larger than 3600 ft2.
3. Lighting for covered vehicle entrances and exits from *buildings* and parking structures shall be separately controlled by a device that automatically reduces the lighting by at least 50% from sunset to sunrise.
4. The power to *luminaires* within 20 ft of any perimeter *wall* structure that has a net opening-to-*wall* ratio of at least 40% and no exterior obstructions within 20 ft, shall be automatically reduced in response to daylight by at least 50%.

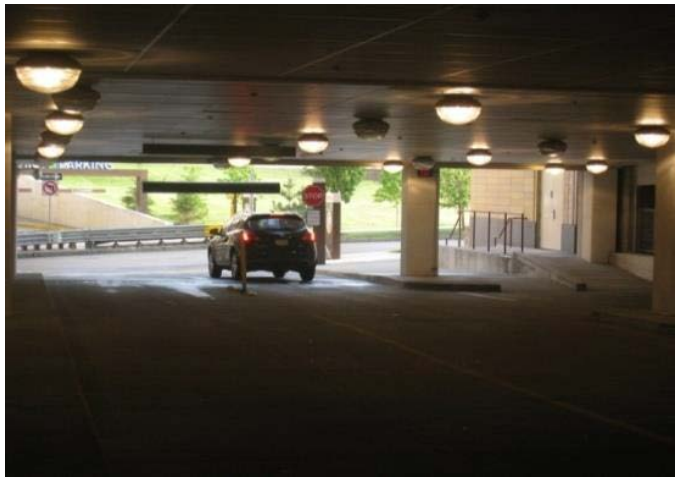


Image Source: Pacific Northwest National Laboratory, Heat, R.

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Dwelling Unit Lighting Requirements

Dwelling units within commercial buildings shall not be required to comply with Sections C405.2 through C405.5, provided that not less than 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 75 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps and that average horizontal illumination levels from permanent fixtures are not below 20 foot-candles.

Image Source: Wikipedia

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Lighting Power Density – *Table C405.3.2(1)*

BUILDING AREA TYPE	LPD (w/ft2) 2019	LPD (w/ft2) Stretch
Dining: cafeteria/fast food	0.79	0.66
Dining: family	0.78	0.61
Health care clinic	0.82	0.68
Hotel/Motel	0.75	0.70
Manufacturing facility	0.90	0.60
Office	0.79	0.69
Parking garage	0.15	0.12
Post office	0.67	0.62
Religious building	0.94	0.72
Retail	1.06	0.91
School/university	0.81	0.67
Town hall	0.80	0.72
Warehouse	0.48	0.41
Workshop	0.90	0.83

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Requirement for Fractional HP Motors

Fractional horsepower fan motors that are 1/12 hp or greater and less than 1 HP which are not covered by Tables C405.8(3) and C405.8(4) shall be electronically commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustment for airflow balancing in lieu of a varying motor speed.

Image Source: Dunmore Motors

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Control of Electrical Receptacles

At least 50 percent of all 125 volt 15- and 20-ampere receptacles installed in private offices, open offices, conference rooms, rooms used primarily for printing and/or copying functions, break rooms, individual workstations and classrooms, including those installed in modular partitions and modular office workstation systems, shall be controlled as required by this section. Either split receptacles shall be provided, with the top receptacle(s) controlled, or a controlled receptacle shall be located within 12 inches (0.30 m) of each uncontrolled receptacle. Controlled receptacles shall be visibly differentiated from standard receptacles and shall be controlled by one of the following automatic control devices:

1. An occupant sensor that turns receptacle power off when no occupants have been detected for a maximum of 20 minutes.

2. 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.

Solar Rooftop Readiness

New ~~low-rise~~ commercial buildings and additions ~~of less than 4 stories above grade~~, with not less than 2,400 square feet of roof area that is either flat or oriented between 110 degrees and 270 degrees of true north.

1. Construction documents shall indicate the solar-ready zone.
2. The total solar-ready zone area shall consist of an area not less than 1,600 square feet, or 50% of the roof area that is either flat or oriented between 110 degrees and 270 degrees of true north.
3. Solar-ready zones shall consist of an area free from obstructions,.
4. The structural design loads for roof dead load and roof live load shall be clearly indicated on the construction documents.
5. Construction documents shall indicate pathways for routing of conduit or plumbing from the solar-ready zone to the electrical service panel or service hot water system.
6. The main electrical service panel shall have a reserved space to allow installation of a dual pole circuit breaker for future solar electric installation and shall be labeled “For Future Solar Electric.”

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Changes
C406

Additional Efficiency Package Options

VERMONT
DEPARTMENT OF PUBLIC SERVICE

2019 CBES Compliance

2018 CBES – Prescriptive

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

AND

- A total of six energy credits from - C406

New buildings shall comply with sufficient packages from Table C406.1 so as to achieve a minimum number of 6 credits.

Stretch guidelines require 9 credits.

- C406.2 – Eff. HVAC Performance
- C406.3.1 – Reduced Lighting Power Density Option 1
- C406.3.2 – Reduced Lighting Power Density Option 2
- C406.4 – Enhanced Lighting Controls
- C406.5 – On-site Supply of Renewable energy
- C406.6 – Dedicated Outdoor Air System
- C406.7.1 and C406.7.2 – High-Efficiency Service Water Heating
- C406.7.1 and C406.7.3 – High-Efficiency Service Water Heating
- C406.7.1 and C406.7.4 – Heat Pump Water Heating
- C406.8 – Enhanced Envelope Performance
- C406.9 – Reduced Air Infiltration
- C406.10 – Efficient Kitchen Appliances

VERMONT

DEPARTMENT OF PUBLIC SERVICE

Building Group Definitions

- R-1 = Occupancies containing sleeping units where the occupants are primarily transient in nature, e.g. hotels/motels
- R-2 = Occupancies containing sleeping units or more than two dwelling units where the occupants are primarily permanent in nature, e.g. apartment houses, dormitories, fraternities/sororities, vacation timeshare
- B = The use of a building for office, professional or service-type transactions, including storage of records and accounts, e.g. banks, civic administration, clinic (outpatient), dry cleaning, electronic data processing
- E = The use of a building by six or more persons at any one time for educational purposes through the 12th grade
- M = The use of a building for the display and sale of merchandise, and involves stocks of goods, wares or merchandise incidental to such purposed and accessible to the public, e.g. department stores, drug stores, markets, retail or wholesale stores, sales rooms

Efficiency Package Credits

Code Section	Commercial Building Occupancy					
	Group R-1	Group R-2	Group B	Group E	Group M	All Other Groups
	Additional Efficiency Credits					
1. More efficient HVAC performance in accordance with Section C406.2.	2.0	3.0	3.0	2.0	1.0	2.0
2.1 Reduced lighting power: Option 1 in accordance with Section C406.3.1.	1.0	1.0	2.0	2.0	3.0	2.0
2.2 Reduced lighting power: Option 2 in accordance with Section C406.3.2.	2.0	3.0	4.0	4.0	6.0	4.0
3. Enhanced lighting controls in accordance with C406.4.	NA	NA	1.0	1.0	1.0	1.0
4. On-site supply of renewable energy in accordance with C406.5.	3.0	3.0	3.0	3.0	3.0	3.0
5. Dedicated outdoor air system in accordance with C406.6[1].	4.0	4.0	4.0	4.0	4.0	4.0

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Efficiency Package Credits

Code Section	Commercial Building Occupancy					
	Group R-1	Group R-2	Group B	Group E	Group M	All Other Groups
	Additional Efficiency Credits					
6.1 High-efficiency service water heating in accordance with Section C406.7.1 and C406.7.2.	7.0	8.0	NA	NA	NA	8.0
6.2 High-efficiency service water heating equipment in accordance with Section C406.7.1 and C406.7.3.	5.0	5.0	NA	NA	NA	5.0
7. Heat pump water heating equipment in accordance with Sections C406.7.1 and C406.7.4.	7.0	7.0	NA	NA	NA	7.0
8. Enhanced envelope performance in accordance with Section C406.8.	3.0	6.0	3.0	3.0	3.0	4.0
9. Reduced air infiltration in accordance with Section C406.9.	1.0	2.0	1.0	1.0	1.0	1.0
10. Efficient kitchen appliances in accordance with C406.10.	5.0	NA	NA	NA	5.0	5.0 (Group A-2 only)

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Changes
C407
System Commissioning

VERMONT
DEPARTMENT OF PUBLIC SERVICE

System Commissioning: *Section C407*

- **Requirements are described in more detail:**
  - Cx Plan
  - Test and Balance
  - Functional HVAC Performance Testing
  - Functional Lighting Testing
  - Commissioning Report
  - Documentation (Construction drawings and O&M manual)

- **Thresholds are reduced**
  - New buildings ≥ ~~50,000~~ 35,000 ft^2

VERMONT
DEPARTMENT OF PUBLIC SERVICE

Code Changes
C501
Existing Buildings

Adopting language from 2018 IECC
No Major Changes

VERMONT
DEPARTMENT OF PUBLIC SERVICE

In closing…opportunities to weigh in

The information presented today has not been decided upon; it is meant to initiate discussion. Attend stakeholder meetings or send comments by July 31, 2018

What	Date	Time	Where
Webinar Overview	July 19th	2:00 – 4:00 pm	On-line
Public Stakeholder Meeting	July 25th	9:00 – 12:00 residential 12:30 – 3:30 commercial Lunch will be provided	Hartford Town Hall (& online) Room 2, 171 Bridge Street White River Junction
Public Stakeholder Meeting	July 26th	9:00 – 12:00 residential 12:30 – 3:30 commercial Lunch will be provided	Burlington Electric Department Auditorium (& online) 585 Pine Street, Burlington
Webinar Overview and Two Public Stakeholder Meetings	October – dates TBD	TBD	TBD
Adoption of Code	March 2019 (estimated)		
Code in Effect	January 2020 (estimated)		

VERMONT
DEPARTMENT OF PUBLIC SERVICE

- Materials will be posted at http://publicservice.vermont.gov/content/building-energy-standards-update

» Q&A

- Send future questions/comments to:
  - Commercial focus: PSD.CodeUpdateComm@vermont.gov
  - Logistical comments/questions: info@energyfuturesgroup.com or Gabrielle Stebbins at 802-482-4014

ENERGY FUTURES GROUP

Cx associates LLC

NAVIGANT

nbi new buildings institute

VERMONT DEPARTMENT OF PUBLIC SERVICE