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Vermont Energy Code Collaborative
CBES Committee Meeting #2

June 2, 2021
2:00 – 4:00

ENERGY FUTURES GROUP

Cx associates LLC

Guidehouse

nbi new buildings institute

Meeting Agenda

1. Overview
   a) Background and Goals of the Collaborative
   b) Introductions
   c) Ground rules, logistics, and use of chat
   d) CBES topics
   e) Meeting schedule
   f) Polling method
2. Today's Topics
   a) Poll results from 1st meeting
   b) Air leakage
   c) Electrification
   d) Building shell insulation
   e) Existing buildings
3. Next CBES Meeting
   a) Polling for topics

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Background & Goals

- Not enough time to go into depth during the three-year energy code update cycle
- This is your opportunity to dive into critical topics in more depth
- Listening and gathering information to inform decisions
  - Hoping for diverse set of perspectives and opinions
- PSD is the ultimate decision-maker, but feedback and input are essential
- Discuss and provide multiple points of view, don't need to reach consensus

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Introductions in Chat

- Name
- Business
- Town
- Area of expertise

https://pointroadgroup.com/introduce-yourself-virtually-make-strong-impressions/

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Code Team: Who

- Lead State Agency
  - Public Service Department
    - Kelly Launder: Assistant Director
    - Keith Levenson: Energy Program Specialist
    - Barry Murphy: EM&V Program Manager
- Code Update Lead and Residential Code
  - Energy Futures Group
    - Richard Faesy, Gabrielle Stebbins & Liz Bourguet
- Commercial Code Update
  - Guidehouse Consulting
    - Keith Downes & Stu Slote
  - Cx Associates
    - Eveline Killian
- National Insights
  - New Building Institute
    - Jim Edelson & Mark Lyles

Ground Rules

- Respectful listening
- Limit comments to less than 2 or 3 minutes
- Give everyone a turn to say something before speaking up again – may use hand raise feature
- State your name when you make a comment for the notes
- Notes
  - Attributed to speakers for future reference
  - Out for review before posting
- Use the chat to ask questions/ clarifications –not for having separate discussions.

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CBES Meetings & Topics

- First meeting: **May 11th 11:00-1:00**
  - Topics from Survey: CBES Compliance, Mechanical Controls, Additional Efficiency Package C406, Maintenance Information and Systems Commissioning C407
- Second meeting: **June 2nd 2:00-4:00**
  - Topics from Poll: Air Leakage, Electrification, Building Shell Insulation, Existing Buildings
- Third meeting: **June 15th 9:00-11:00**
  - Topics: Open to input from participants

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Code Collaborative Meetings

- **Cross Cutting**
  - #1 – May 4, 11:00 – 1:00
  - #2 – June 8, 11:00– 1:00
- **Commercial**
  - #1 – May 11, 11:00 – 1:00
  - #2 – June 2, 2:00 – 4:00
  - #3 – June 15, 9:00–11:00
- **Residential**
  - #1 – May 13, 3:00 – 5:00
  - #2 – June 15, 3:00 – 5:00
- **Multifamily**
  - #1 – June 10, 1:00–3:00

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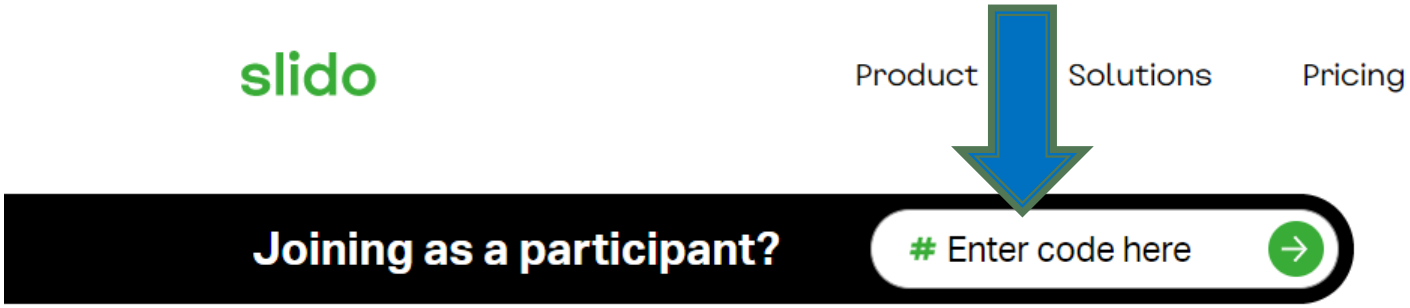
Polling

- Throughout our discussion, we will be asking you to respond to poll questions
- Before we get started, please go to https://www.sli.do/
- Enter **597936** into the field at the top of the website



- Leave this webpage open throughout our discussion
- We will let you know when it is time to answer a question

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Poll Results from First CBES Meeting

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Poll: Next Code LPD

Lighting Power Density: Assuming the next code will strive for higher-efficiency, what should we do with LPD?

Stricter LPD allowances, LPD has more potential for savings than other sections of the code

21%

Moderately stricter LPD allowances, make LPD proportionally more difficult as other sections of the code

79%

Leave LPD alone, LPD is already too difficult to achieve

0%

Loosen LPD allowances, the 2020 code went too far and we need to make it easier

0%

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Poll: Additional Efficiency Packages

Additional Efficiency Package C406: What should the next revision of C406 look like?

Continue down the path we are currently on with points and multiple options

27%

Defer to 2021 IECC C406

45%

Simplify to things such as LPD, envelope, mechanical and renewable energy, but still on a point system by building type

18%

Simplify to things such as LPD, envelope, mechanical and renewable energy, but no distinction between building types

0%

Eliminate C406, which means other sections would be even more stringent

18%

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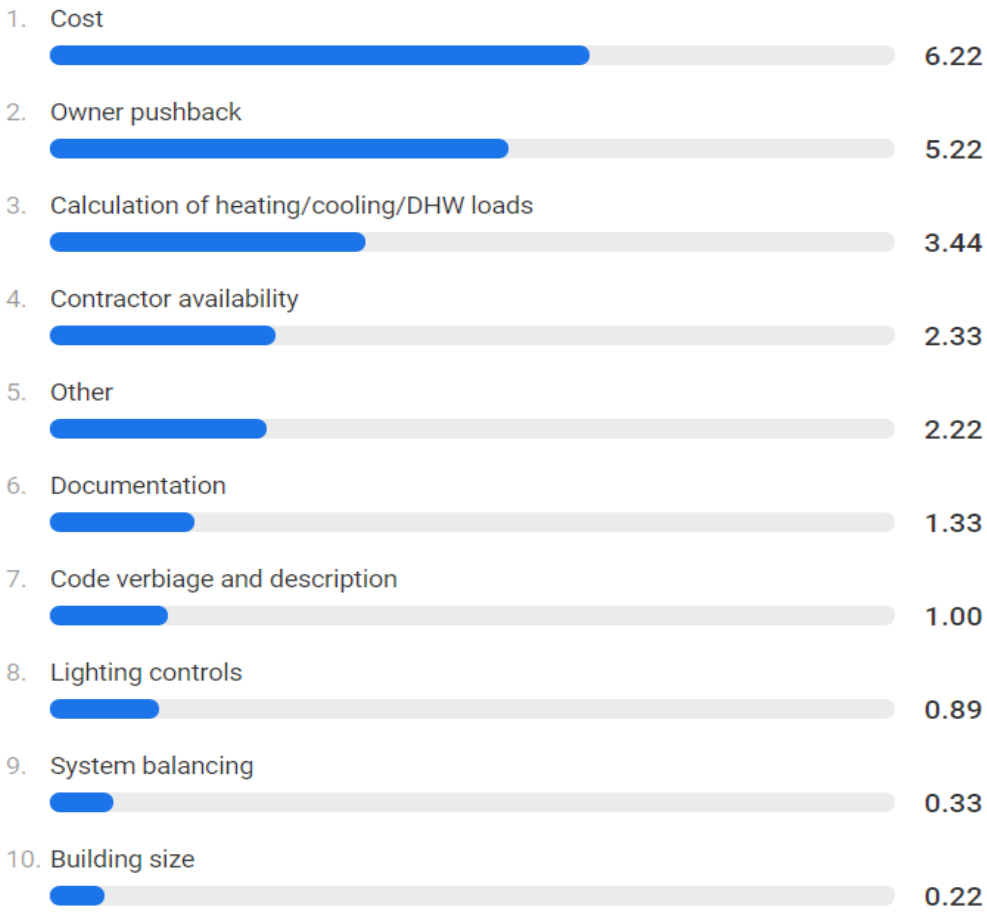
Poll: Commissioning Issues

Commissioning – where are the issues?



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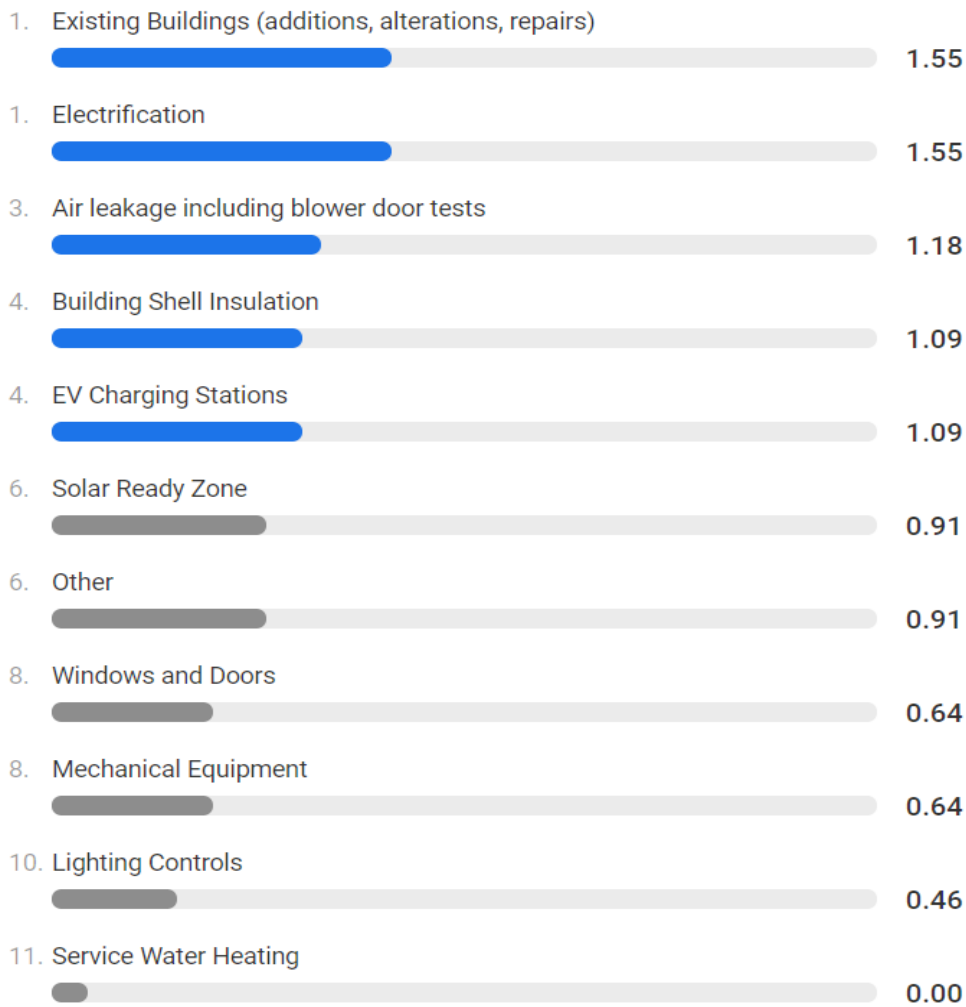
Poll: Topics for 2nd CBES meeting



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» Air Leakage

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Air Leakage

- Why did you select air leakage as a topic for discussion?
- Are there specific suggestions/issues?

- Topics for Discussion:
  - Does everyone in the marketplace do blower door testing?
  - How effective is the air barrier commissioning section?
  - Are there any issues with the vestibule section?
  - Is there room to tighten the air sealing requirements?
  - Are the corrective actions if you fail the air barrier performance test sufficient?
  - Should we move to performance testing as the only option to comply with code?

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» Electrification

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Electrification

- Why did you select electrification as a topic for discussion?
- Are there specific suggestions/issues?

- Topics for Discussion:
  - Is this an overall issue or specific to a particular area?
  - Make a proposal we can all discuss.
  - Has the inclusion of Cold Climate Heat Pumps and lack of fossil fuel backup caused any issues?
  - Are renewables an issue?
  - Are there pushbacks from customers, designers and/or contractors?

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Building Shell Insulation

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Building Shell Insulation

- Why did you select building shell insulation as a topic for discussion?
- Are there specific suggestions/issues?

- Topics for Discussion:
  - Is this an overall issue or specific to a particular area?
  - Make a proposal we can all discuss.
  - Does anyone use the building above-grade performance alternative?
  - Is it more cost effective to have more insulation or have higher-efficiency mechanicals?

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Existing Buildings

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Existing Buildings

- Why did you select Existing Buildings as a topic for discussion?
- Are there specific suggestions/issues?

- Topics for Discussion:
  - Alterations/Additions
  - Electrification
  - Weatherization
  - Renewables
  - Determination of Compliance

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Next CBES Meeting

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Next CBES Meeting

- What topics would you like to see discussed at the next and last CBES meeting?

- Possible Topics:
  - Mechanical Equipment
  - Service Water Heating
  - Lighting Controls
  - EV Charging Stations
  - Solar Ready Zone and On-site renewables
  - Compliance
  - Future CBES efficiency improvements to meet energy and carbon goals
  - Other (Specify)

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Thank You for Participating!

Next Meetings:

June 8 – Cross Cutting Committee Meeting 11-1pm

June 10 – Multifamily Committee Meeting 1-3pm

June 15 – Commercial Committee Meeting 9-11am

June 15 – Residential Committee Meeting 3-5 pm

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Appendix

Code Changes
C402 Building Envelope

Summary of Major Changes: Building Envelope

- New definitions for building envelope
- R-Values / U-factors updates
- Roof assemblies
- New assembly U-factor tables
- Increased fenestration requirements
- Building above-grade performance alternative
- Air leakage section reorganized
- Construction documents must include air barrier information

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Summary of Major Changes: Building Envelope (continued)

- Air leakage compliance via testing reduced to 0.30 CFM/SF
- Air barrier commissioning
- Air leakage tests for dwelling units
- Vestibules
- Rooms with fuel-burning appliances that are not direct vented

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New Definitions for Building Envelope

CONDITIONED SPACE. An area, room or space that is enclosed within the building thermal envelope and is directly or indirectly heated ~~or cooled~~ **by a heating system whose output capacity is greater than 14 Btu/h·ft^2 of floor area or directly or indirectly cooled by a cooling system whose sensible output capacity is greater than or equal to 3.4 Btu/h·ft^2 of floor area.** Spaces are indirectly heated or cooled …

SEMI-CONDITIONED SPACE. An enclosed space within a building that is directly or indirectly heated by a heating system whose output capacity is less than or equal to 14 Btu/h·ft^2 of floor area; or if the space is directly or indirectly cooled and the cooling system's sensible output capacity is less than 3.4 Btu/h·ft^2 of floor area.

MULTIFAMILY DWELLING. A building containing three or more dwelling units where the occupants are primarily permanent in nature and which are adjacent vertically or horizontally. If built side-by-side, at least one of the following is true: (1) they do not have a wall that extends from ground to roof, (2) they share a heating system, or (3) they have interstructural public utilities such as water supply/sewage disposal.

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Building Envelope – *Table C402.1 – Roofs*

Component	2015 CBES	2018 IECC	2019 CBES
Roof – Above Deck	R-30ci	R-30ci	R-40ci
Roof – Metal Building	R-25 + R11 LS	R-25 + R11 LS	R-25 + R-11 + R11 LS
Roof – Attic and Other	R-49	R-49	R-49

Per stakeholder comment we now have requirements for semi-conditioned spaces.

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Building Envelope – *Table C402.1 – Walls Above Grade*

Component	2015 CBES	2018 IECC	2019 CBES
Mass	R-13.3 ci	R-13.3ci	R-19ci
Metal Building	R-13 + R-13ci or R19.5ci	R-13 + R-13ci	R-13 + R-17ci or R22.1ci
Metal Framed	R-13 + R-7.5ci or R-13ci	R-13 + R-7.5ci	R-13 + R-15ci or R-20ci
Wood Framed and others	R-13 + R-7.5ci or R-20 + R3.8ci or R-23 or R-15ci	R-13 + R-7.5ci or R-20 + R3.8ci	R-13 + R-12ci or R-19 + R8ci or R-20ci

Per stakeholder comment we now have more U-factor reference tables available for more construction types.

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Building Envelope – *Table C402.1 Floors*

Component	2015 CBES	2018 IECC	2019 CBES
Mass	12.5ci	R-12.5ci	R-16.7ci
Joist/Framing – Metal	R-38	R-30	R-38
Joist/Framing – Wood and Other	R-30	R-30	R-30
Unheated Slabs	R-10 for 48”	R-10 for 24”	R-10 entire slab
Heated Slabs	R-10 entire slab	R-15 for 36” + R-5 entire slab	R-20 entire slab

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Roof Assemblies

Exceptions:

1. Continuously insulated roof assemblies where the R-value is at least R-12 over the entire roof assembly and where the average, area-weighted R-value is equivalent to the *R*-value specified in Table C402.1(1).

2. A minimum of 60% of the required R-value from Table C402.1(1) must be maintained in area where the roof insulation tapers, such as at roof drains.

3. Mechanical curbs shall be insulated to R-12.

4. Skylight curbs shall be insulated to the level of roofs with insulation entirely above the deck or R-10, whichever is less.

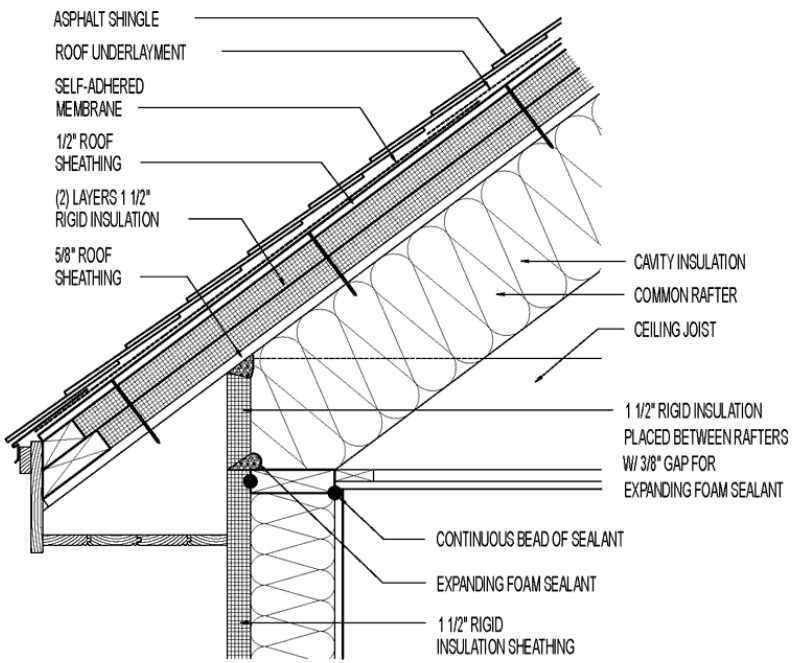

Image Source: Green Building Advisor

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New Assembly U-Factor Tables

New tables for:

- Attic roofs with wood joists
- Metal framed walls
- Wood framed walls

ASSEMBLY *U*-FACTORS FOR METAL-FRAMED WALLS

RATED *R*-VALUE OF CAVITY INSULATION (EFFECTIVE INSTALLED)	OVERALL U-FACTOR FOR BASE WALL ASSEMBLY	OVERALL *U*-FACTORS FOR ASSEMBLY OF BASE WALL PLUS CONTINUOUS INSULATION (UNINTERRUPTED BY FRAMING)								
		R-12	R-13	R-14	R-15	R-20	R-25	R-30	R-35	R-40
Steel Framing at 16 in. on Center and 3.5 in. Depth										
R-0 (0.0)	0.352		0.063	0.059	0.056	0.044	0.036	0.030	0.026	0.023
R-11 (5.5)	0.132	0.051	0.049	0.046	0.044	0.036	0.031	0.027	0.024	0.021
R-13 (6.0)	0.124	0.050	0.048	0.045	0.043	0.036	0.030	0.026	0.023	0.021
R-15 (6.4)	0.118	0.049	0.047	0.045	0.043	0.035	0.030	0.026	0.023	0.021
Steel Framing at 16 in. on Center and 6.0 in. Depth										
R-19 (7.1)	0.109	0.047	0.045	0.043	0.041	0.034	0.029	0.026	0.023	0.020
R-21 (7.4)	0.106	0.047	0.045	0.043	0.041	0.034	0.029	0.025	0.022	0.020
Steel Framing at 24 in. on Center and 3.5 in. Depth										
R-0 (0.0)	0.338		0.063	0.059	0.056	0.044	0.036	0.030	0.026	0.023
R-11 (6.6)	0.116	0.048	0.046	0.044	0.042	0.035	0.030	0.026	0.023	0.021
R-13 (7.2)	0.108	0.047	0.045	0.043	0.041	0.034	0.029	0.025	0.023	0.020
R-15 (7.8)	0.102	0.046	0.044	0.042	0.040	0.034	0.029	0.025	0.022	0.020
Steel Framing at 24 in. on Center and 6.0 in. Depth										
R-19 (8.6)	0.094	0.044	0.042	0.041	0.039	0.033	0.028	0.025	0.022	0.020
R-21 (9.0)	0.090	0.043	0.042	0.040	0.038	0.032	0.028	0.024	0.022	0.020

Shaded areas comply with minimum requirements for semi-conditioned spaces but not conditioned spaces.

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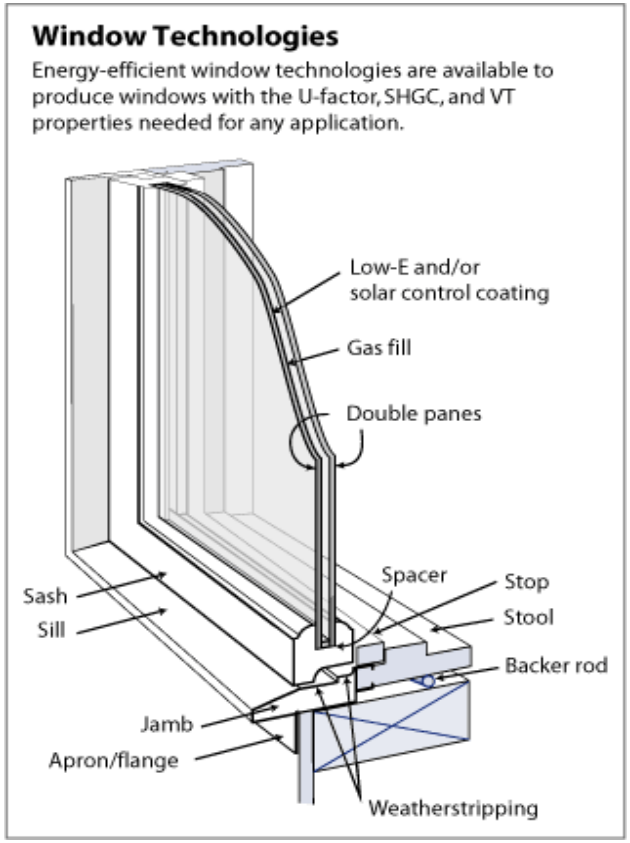
Fenestration – *Table C402.3*

Component	2015 CBES	2019 CBES
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



Semi-conditioned spaces are exempt from fenestration requirements.

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

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Building Above-Grade Performance Alternative

This is an alternative to compliance with the *U*-factors in Tables C402.1(1) and C402.3 and the maximum allowable fenestration areas in Section C402.3.1. Below-grade walls, floors, and slabs shall meet the applicable requirements of Section C402.1.1 or C402.1.2. *Fenestration* shall meet the applicable SHGC requirements of Section C402.3.3.

UA-Total / Area < 0.035

UA-Total	=	Sum of the (UA) values for each distinct above-grade assembly type of the building thermal envelope including above-grade walls, roofs, doors, vertical fenestration, and skylights.
UA	=	Proposed U-value × Area.
Area	=	Surface area in square feet of the above-grade thermal barrier (above-grade wall area plus roof area).

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Air Leakage Section Reorganized

Must comply with sections C402.4.1 through C402.4.5

- Air barriers
- Dwelling unit air infiltration
- Air intakes, exhaust openings, stairways and shafts
- Loading dock weatherseals
- Vestibules

Air barriers is satisfied by C402.1.1 OR C402.1.2 through C402.1.8

- Air barrier performance testing
- Continuous air barrier commissioning
- Air barrier construction
- Air barrier compliance (either Materials or Assemblies)
- Air leakage of fenestration
- Rooms containing fuel-burning appliances that are not direct vented
- Doors and access opening to shafts, chutes, stairways and elevator lobbies
- Recessed lighting

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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.

Air Leakage Compliance via Testing

Tested air leakage rate of the building thermal envelope is not greater than ~~0.50~~ 0.30 cfm/per square foot of shell area ~~(excluding area of slab and below grade walls)~~ at ~~50~~ 75 Pa, six sided surface area.

But there is an exemption if you fail to achieve 0.30 CFM/SF

Where the measured air leakage rate exceeds 0.30 cfm/ft2 but does not exceed 0.40 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.

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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

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Air Barrier Commissioning Checklist

RELATED SYSTEMS, EQUIPMENT, ASSEMBLIES AND COMPONENTS	TASKS/COMMENTS
Foundations subsoil drainage system	Verify compliance with approved plans, specifications and construction documents.
Foundation damp-proofing and waterproofing	
Flashing at: exterior doors, skylights, wall flashing and drainage systems	
Exterior wall coverings	
Moisture envelopes	Where applicable meet owner's project requirements (OPR), Basis of Design (BOD), Cx Specifications.
Exterior below-grade walls	Check for proper drainage system at exterior wall perimeter to keep water from entering building.
External floor and soffits, slab-on grade	Check for thermal resistance or insulation when required. Slabs: Check drainage for moisture penetration.
Exterior walls	Check drawings for wall assembly requirements.
Exterior glazed window fenestration: windows, glazed doors and skylights	Drawing reviews and contractor submittal reviews: • Check that fenestration products are labeled with a U-factor (see NFRC 100) and a solar heat gain coefficient (SHGC) (see NFRC 200), and certification for the air infiltration requirement. • Check for proper flashing and caulking at walls and roof assemblies. Glazed doors: • Check for proper flashing, and seals and gaskets; and proper pull force, if provided with a closer. • Check for proper door swing.

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Air Barrier Commissioning Checklist (continued)

Site-built fenestration: curtain walls and store-front systems, and atrium roof systems	Check for a label certificate issued by the National Fenestration Rating Council (NFRC) or a label certificate issued by the glazing fabricator that meets the default U-factor and SHGC; or an NFRC component modeling approach (CMA) label certificate or another approved standard. • Check for proper door swing.
Field-fabricated fenestrations: fenestration made at the site, not preformed or cut	Check for compliance with the default U-factor and the default SHGC.
Exterior doors	Check for proper flashing installation at header, walls and floor. • Check for U-factor requirements for swinging and nonswinging doors. • Check for appropriate manufacturer's referenced standard [American Architectural Manufacturer's Association (AAMA); Canadian Standards Association (CSA); and Window and Door Manufacturer's Association (WDMA) or other approved standard] product data sheets.
Sealants, control joints and flashing (stationary and moveable)	Check for proper installation in accordance with the manufacturer's written instructions
Shading devices	Check for proper anchoring to building with proper flashing at wall connections.
Structural systems	Check for proper anchoring in accordance with construction documents, including metal connectors and beam supports.

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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 0.35 cfm/ft2 at 75 Pa and six-sided surface area.

- Tested units will be randomly selected
- The sampling of dwelling units tested shall include at least 10 percent of the dwelling units in each building
- Including at least one corner unit.
- Approximately an equal number of units on each floor level.
- At least one unit on each floor level.

Image Source: The Energy Conservatory

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Vestibules

New Requirements:

1. Interior and exterior doors shall have a minimum distance between them of not less than 7 feet.
2. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space.
3. Either the interior or exterior envelope of unconditioned vestibules shall comply with the requirements for a conditioned space.

New Exemptions:

1. Doors used primarily to facilitate vehicular movement or material handling and adjacent personnel doors.
2. Elevator doors in parking garages provided that the elevators have an enclosed lobby at each level of the garage.
3. Doors opening directly from a semi-conditioned space.

Rooms Containing Fuel-Burning Appliances

2015 CBES:
Where open combustion air ducts provide combustion air to open combustion space conditioning fuel-burning appliances, the appliances and combustion air openings shall be located outside of the building thermal envelop or enclosed in a room isolated from inside the thermal envelope.

2019 CBES:
Where combustion air is supplied through openings in an exterior wall to a room or space containing a space-conditioning fuel-burning appliance, one of the following shall apply:

1. The room or space containing the appliance shall be located outside of the *building thermal envelope.*
2. The room or space containing the appliance shall be enclosed and isolated from conditioned spaces inside the building thermal envelope. Such rooms shall comply with all of the following:

ASHRAE 90.1 – 2016 Performance Rating method used for energy modeled buildings (Appendix G)

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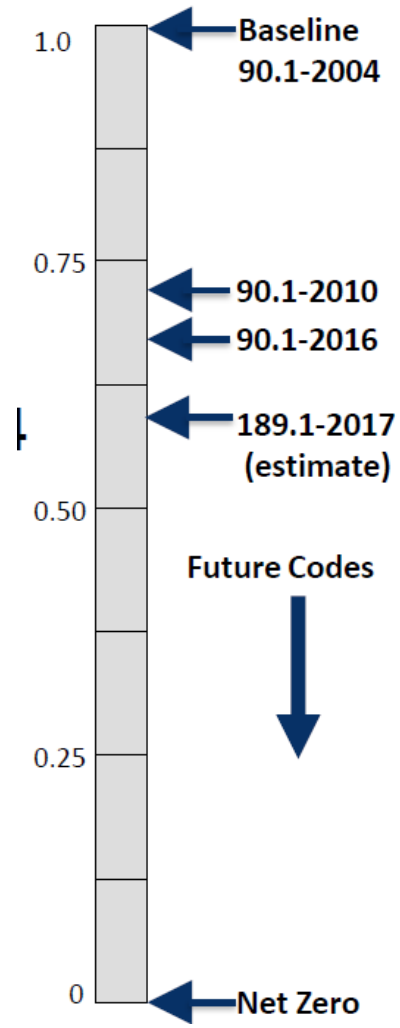
New Compliance Path

- 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

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Performance Cost Index

- PCI shall be fuel neutral
  - PCI = BPF * (BBUEC + BBREC)/BBP, where
    - BPF = Building Performance Factor
    - BBUEC = Baseline Building Unregulated Energy Cost
    - BBREC = Baseline Building Regulated Energy Cost
    - BBP = Baseline Building Performance

Building Area Type	Proposed Code BPF
Multifamily	0.62
Healthcare/hospital	0.46
Hotel/motel	0.48
Office	0.43
Restaurant	0.50
Retail	0.44
School	0.39
Warehouse	0.53
All Others	0.45

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Code Compliance Studies

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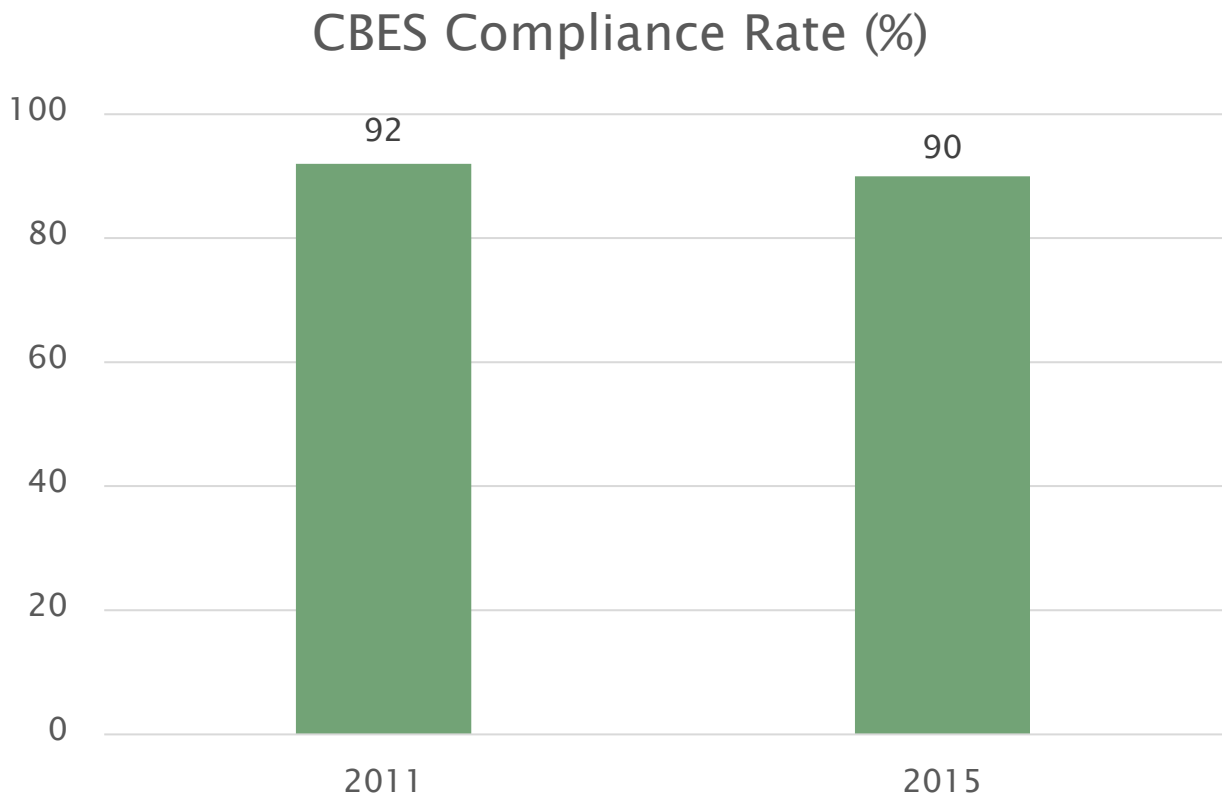
Market Baseline Studies

2012 Study: "Vermont Energy Code Compliance Plan – Achieving 90% Compliance by 2017"

Respondents reported that 66% of projects undertaken exceed the minimum CBES requirement



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Compliance Approach

	2020 Approach	Required Documents
	2020 CBES Prescriptive	CBES Certificate and COMcheck
	ASHRAE 90.1 – 2016 Sections 5-10 with Amendments	CBES Certificate and COMcheck
	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

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Survey Response

- Would you support stricter code compliance?
  - All respondents said: **Yes**
- If yes, how would you suggest getting more code compliance
  - All respondents said: **on-site inspections by a code official**
- Comments:
  - We need code officials who are knowledgeable and assistive in explaining the code, making formal interpretations for unusual cases, and visiting job sites to confirm construction complies with critical design elements – exactly as is done for other issues of public welfare.
  - The state can have an energy evaluator that has space in the fire marshals' offices and reviews plans. A separate form and fee would be required. I think one or two people could cover the entire state from a review standpoint.
  - Compliance starts with contractor registration.

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Compliance Questions

- If compliance is important, then how do you think we should do it?
- Would a builder Registry be effective?
- What are our options besides the builder Registry?
- Could builder certification be effective?
- What ideas besides code officials?
- Are you for or against builder licensure?

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