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Vermont Codes Update Trainings – Residential Building Energy Standards (RBES)

June 11, 2019
Burlington, VT

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

ENERGY FUTURES GROUP

Cx associates LLC

NAVIGANT

nbi new buildings institute

EFFICIENCY EXCELLENCE NETWORK

Efficiency Vermont

Presentation Overview

1. Welcome & Introductions (9:00 – 9:20)
   - Background & Framework
   - Schedule & Process
   - Opportunity for Input
2. Code Compliance (9:20 – 9:30)
3. Existing Code Requirements Summary (9:30 – 9:50)
4. Proposed 2019 Updates (9:50 – 11:20)
   - 10 minute break when needed
5. Discussion (11:20 – 11:55)
   - With Dave Keefe
6. Wrap Up (11:55 – 12:00)
7. Lunch (12:00 – 12:30)
8. CBES (12:30 –4:30)

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» Introduction

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Code Overview: 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 & Emily Bergan
- Commercial Code Update
  - Navigant Consulting
    - Keith Downes & Stu Slote
  - Cx Associates
    - Eveline Killian & Jen Chiodo
- Roadmap
  - New Building Institute
    - Jim Edelson
    - Eric Makela
- Code Implementation Support
  - Efficiency Vermont
    - Brian Just

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Who is in the room?

- Builders/General Contractors
- Architects/Designers
- Engineers
- Trades/Subcontractors
- Home Performance Contractors
- Building Officials
- Building Suppliers
- Utility
- Affordable Housing
- Other: _____?

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Background
» & Framework

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Energy Code Background

- Vermont Residential Building Energy Standard (RBES) – 30 V.S.A. § 51 affects all new homes and all additions and renovations built after July 1, 1998
- All residential buildings 3 stories or less
- RBES versions:
  - 1997
  - 2005
  - 2011
  - 2015
  - 2019 (in effect January 2020)

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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 reduce fossil fuel use) will drive a shift to electricity
- 2011 Comprehensive Energy Plan (all new buildings designed to net zero by 2030)
- And more…resolutions and agreements regarding strategic electrification, electric vehicles, limiting emissions, etc.

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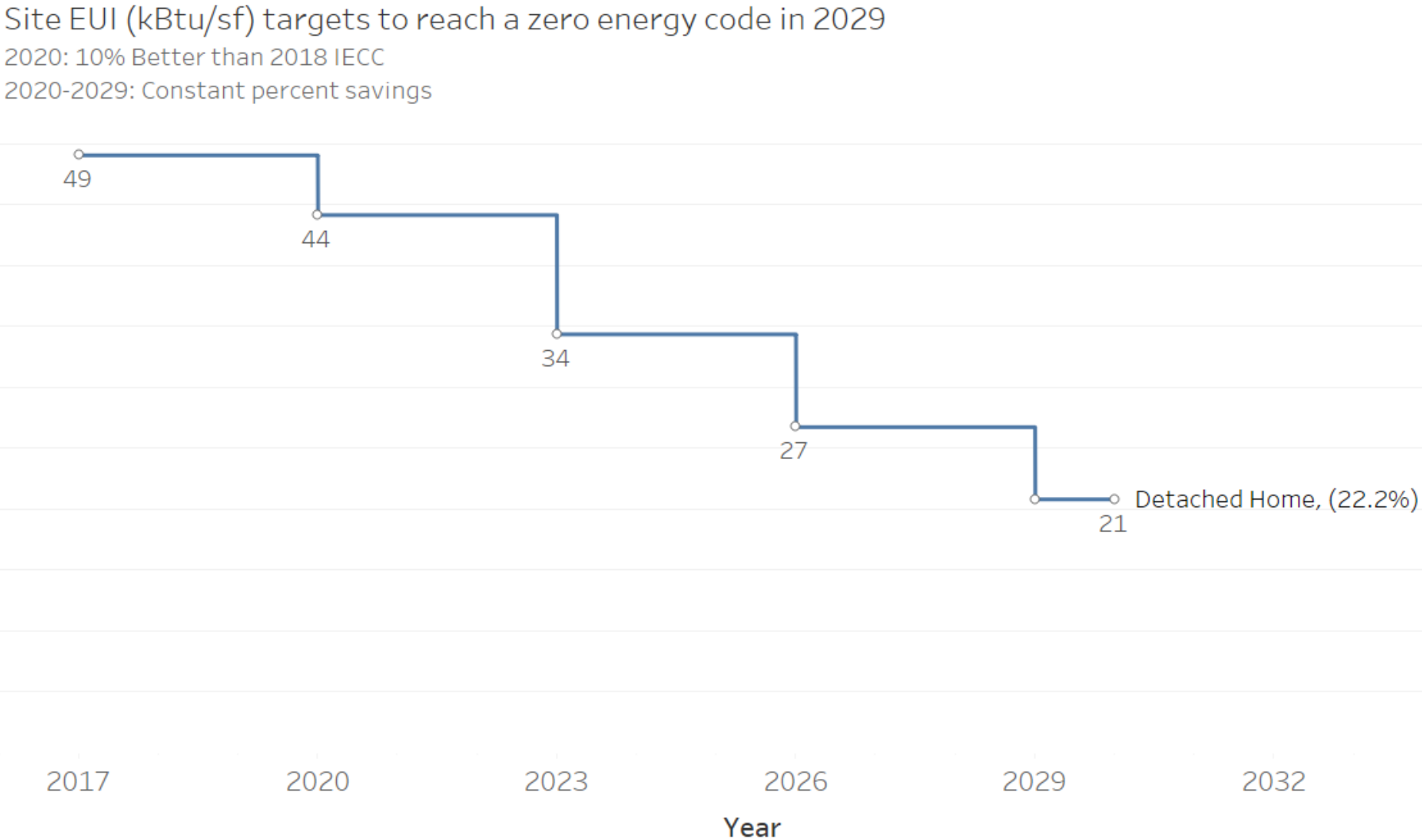
Progress to 2030



Schedule & Process

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Code Update: Stakeholder Engagement Completed So Far

- Vermont stakeholder meetings
  - July 2018 in Hartford & Burlington
- Advisory Committee meetings
  - August in Montpelier
- Follow up stakeholder meetings
  - October conference call
  - Affordable housing stakeholders
- Follow up Advisory Committee meetings
  - October in Montpelier
- 2019 Better Buildings by Design Conference
- May 1 VT BSA Training in Montpelier

- 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)
  - Etc.

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Code Update: Schedule

- May 2019
  - *Montpelier Training, ICAR Process, file with Secretary of State May 2019*
- June 2019
  - *Burlington Training, Public Comments* ***June 2019***
- July 2019
  - *Public Hearing (Statehouse) June 21,2019*
- August 2019
  - *LCAR Process July/August/September 2019*
- September 2019
  - *Rule Adopted September 2019*
- October 2019
- November 2019
- December 2019
  - *Rule Enacted December,31 2019*
- January 2020
  - *Begin Code Collaborative 2020 - 2021*

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Additional Opportunities for Input

- Revised code language has been filed with the State ICAR public review process
- Public hearing June 21(Room 11, Statehouse)
  - Please send public comments by June 19th so they may be addressed at the hearing
- Opportunity for written comments through July 10
  - http://publicservice.vermont.gov/content/building-energy-standards-update
- LCAR Process
  - July 23 goal date for submission
  - August hearing

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Code Compliance

Energy Code Compliance

	2002 Study (n=158)	2008 Study (n=106)	2011 Study (n=97)
Compliance Rate	58%	72%	74%

- 2015 PSD study due out shortly
  - Expected slightly lower compliance results
- Code compliance is an issue that needs to be resolved, but is not addressed through the code update process
- Need to level the playing field for all builders

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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's "Municipal Guide")
  - Department of Public Safety has been asked to check for RBES certificate
  - Act 250 requires stretch code compliance
  - Efficiency Vermont provides code trainings and support
  - Some lenders and closing attorneys require
  - Builder licensing/registration efforts considered

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Code Compliance & Enforcement

- S.163 Builder Registry
  - Passed VT Senate
- Builder collaborative to promote code enforcement
- Address in PSD Energy Code Collaborative

"I'm right there in the room, and no one even acknowledges me."

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Energy Code Collaborative

- Dept of Public Service initiative in later 2019 – 2020
- Issues to address:
  - Compliance
  - Enforcement
  - Administration
  - Definition of 'net-zero design'
  - Embodied carbon
  - Standards and measures in next codes
  - Etc.

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RBES Overview & Summary

Slides provided by D. Keefe, Efficiency Vermont

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The Legislation -- Act 20 of 1997 "Residential Building Energy Standards"

- Based on International Energy Conservation Code (IECC)
  - Performance-based standard
  - Some Vermont-specific additions/exempt
- Self-certification by builder
- Three-year revision cycle
  - Public review process

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Which Buildings Must Comply?

- New construction, low-rise residential
  - One and two family dwellings
  - Multifamily housing three stories or less
  - Does *not* include commercial buildings
    - But *does* include residential part of mixed-use
- Existing low-rise residential buildings
  - Additions
    - Only the addition needs to conform
  - Renovations, window & equipment replacement

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What's Required?

- Basic Requirements
- Performance Requirements -- Three Methods
  - Prescriptive Method
  - RES*check* Software
  - ☆ Home Energy Rating
- Certification

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Exemptions

- Extreme low energy use
  - less than 1 watt per square foot peak load
- Mobile homes
  - Title VI, National Manufactured Housing Construction & Safety Standards Act of 1974
  - Site-constructed components still must comply
- Buildings (or areas) not heated or cooled
- Hunting camps
- Summer camps with biomass or on-site renewable heating
- Yurts with biomass or on-site renewable heating and hot water
- Historic buildings can apply for exemption

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Change of Occupancy or Use

- Section R505
- Code compliance required if:
  - Spaces undergoing a change in use that would result in an increase in demand for either fossil fuel or electrical energy
  - Any space that is converted to a dwelling unit or portion thereof from another use
- Summer camps or hunting camps that install automatic heating systems or convert from "unconditioned space" to "conditioned space" must comply

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Owner/Builder Projects

- Specifically exempted from meeting the technical requirements of the code
- Owner must direct the details of construction, including energy items, and must live in the building
- Must do calculations, complete and file the Owner/Builder Disclosure Statement
- Must disclose in writing to potential buyers before purchase and sale agreement

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Liability

- Homeowner may take civil action against person certifying building
- Damages may include increased energy costs and costs to bring the building into compliance (as well as court, attorneys' fees)
- Claims must be filed within six years

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Stretch Code

- Separate, more stringent code
- As of Dec 1, 2015, all Act 250 projects need to meet stretch code
- Available for towns to voluntarily adopt

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RBES Certificate – will be modified

2019 Vermont Residential Building Energy Standards (RBES) Certificate

This certificate is for projects started on or after January 1, 2020.

Before completing this form, refer to the instructions in Chapter 8 of the Residential Energy Code Handbook (5th edition).

For additions, alterations, renovations or repairs, only fill out applicable portions of certificate.

_____ Property Address (Street, City, ZIP Code)

_____ Act 250 Permit # _____ ☐ NA

_____ Electric Utility serving this address

_____ Construction START Date

_____ Construction FINISH Date

Applicable Code: ☐ Base ☐ Stretch

Project Description
☐ Single family ☐ Renovation / alteration[1]
☐ Multi family ☐ Addition[1]
☐ Log home ☐ Repair[1]

_____ # Units _____ # Stories _____ # Conditioned Sq. Ft. _____ # Bedrooms

Foundation: ☐ Basement ☐ Slab On Grade ☐ Crawl Space ☐ Other: _____

[1]Existing Home Project Description: _____

Compliance Method (must select one)

☐ ***Option 1:*** *Package-Plus-Points*
_____ Package # (indicate base or stretch, and number)
____ / ____ Points required / achieved (verify via checklist below)

☐ Envelope: Slab, R-10 under all (1)
☐ Envelope: Walls-Upgraded, R20+12 (2)
☐ Envelope: Walls-High-R, R-40 (3)
☐ Envelope: Ceiling, R-80 flat / 60 sloped (1)
☐ Envelope: Windows 0.27 (1, Base only)
☐ Envelope: Windows 0.22 (2)
☐ Pre-drywall blower door (1), result _____
☐ ENERGY STAR heating and cooling (1)
☐ Advanced heating and cooling (3)

☐ ACH50 ≤ 2.0 and qualifying HRV/ERV (3 for Base / 1 for Stretch)
☐ ACH50 ≤ 1.0 and qualifying HRV/ERV (4)
☐ ENERGY STAR DHW (1)
☐ ENERGY STAR electric DHW (2)
☐ Low flow fixtures (1)
☐ Water certification (2), cert. type _____
☐ Drain water heat recovery (1)
☐ User-demand hot water recirculation (1)

☐ Solar ready (1, Base only[1])
☐ On-site generation (1-4)
____ kW ____ pts
☐ Solar hot water (2)
☐ Building energy monitoring (1)
☐ Level 2 EV-ready (1)
☐ 6 kWh battery backup (1)
[1]See RBES for MF exception

☐ ***Option 2:*** *REScheck software*
(attach REScheck report)
_____ UA result

☐ ***Option 3:*** *HERS/ERI*
_____ HERS / ERI Result (Overall)
_____ HERS / ERI without Renewables
_____ Approved Rater Name
_____ REM/Rate Version #
☐ IAF incorporated

(Maximum HERS/ERI: 61 Base, 54 Stretch)

Thermal Envelope

R-_____ Basement / Crawl Space Walls
R-_____ Unheated Slab (Under)
R-_____ Above-Grade Walls
R-_____ Floors over Unheated Spaces
U-_____ Windows ☐ NFRC ☐ Default

_____ Basement Insulation Depth (ft)
R-_____ Heated Slab (Under)
R-_____ Flat Ceilings _____ Area (sq ft)
R-_____ Attic Access Hatch / Door ☐ NA
U-_____ Doors ☐ NFRC ☐ Default

U-_____ Basement Windows ☐ NFRC ☐ Default
R-_____ Perimeter Slab Edge
R-_____ Sloped Ceilings _____ Area (sq ft)
U-_____ Skylights ☐ NFRC ☐ Default

Air Sealing / Blower Door Test (must report either ACH50 or CFM50/sq ft)

_____ ACH50
_____ CFM50/sq ft of building shell (6 sides)
For Stretch Code, both measurements are required

_____ Date of test
_____ Authorized Air Leakage Tester Name

Ventilation System (must select one)

☐ Balanced, SRE _____
☐ Exhaust-Only

Verification: ☐ Rated ☐ Measured →

_____ Exhaust air flow (total)
_____ Supply air flow (total) ☐ NA (Exhaust-Only)

Combustion Safety (verify all)

☐ Exterior (outdoor) air supply is provided for solid fuel-burning appliances and fireplaces or ☐ NA (no solid fuel burning appliance or fireplace in home)
☐ Solid fuel burning appliances and fireplaces have gasketed doors with compression closure or ☐ NA (no solid fuel burning appliance or fireplace in home)
☐ Spillage testing conducted on combustion equipment not directly-vented or ☐ NA (no equipment, or all equipment directly-vented)

Mechanical System (must complete all)

Design Load Calculation Method: ☐ ACCA Manual J ☐ Other Approved Method (List) _____
Calculation details: (Ref. RBES R302 for design temperature exceptions)

_____ Winter design outdoor temp, dry-bulb (typ. min. -11F)
_____ Winter design interior temp (max 72F)
_____ Heating design load, Btuh
_____ Primary heating system size, Btuh
_____ HSPF or AFUE (efficiency)

_____ Summer design outdoor temp, dry-bulb (typ. max. 84F) or ☐ No cooling
_____ Summer design indoor temperature (min. 75F) or ☐ No cooling
_____ Cooling design load, Btuh or ☐ No cooling
_____ Primary cooling system size, Btuh or ☐ No cooling
_____ SEER or COP (efficiency) or ☐ No cooling

☐ Programmable thermostat or ☐ Exempt (list reason _____)

Ducts

☐ Ducts located completely within conditioned space or ☐ NA (no ducts)
_____ Duct tightness result (CFM @ 25 Pa)
Test performed at ☐ Rough-in (max 3 CFM per 100 sq ft of cond. floor area) ☐ Post-construction (max 4 CFM per 100 sq ft of cond. floor area)

Other Requirements

Mandatory (Base and Stretch):
☐ Mechanical system piping, min. R-3
☐ 80% of lamps in permanently installed fixtures are high efficacy
☐ Multi family: EV charging requirement is met: _____ # spaces
☐ Automatic or gravity dampers for vent. system intake and exhaust

Mandatory (Stretch Code Only):
☐ Single-family: One Level 1 EV-charging space
☐ Single-family: Solar ready

Where applicable:
☐ Circulating service hot water piping, R-3
☐ Pool cover for all heated pools
☐ Accessible on-off switches for pool heaters
☐ Automatic time switches for pool heaters
☐ Automatic controls for snow-melt systems

I certify to _____ (Owner) that the above information is correct and that the premises listed **have been constructed in accordance** with the Vermont Residential Building Standards (RBES) created under 30 V.S.A. § 51.

Signature: _____ Printed Name: _____
Company: _____ Phone: _____ Date: _____

30 V.S.A. § 51 requires this certificate label to be permanently affixed to the inside electrical service panel or heating or cooling equipment or nearby in a visible location. Copies also must be provided to 1) the Dept. of Public Service, Planning & Energy Resources Division, 112 State St., Montpelier, VT 05602, and 2) the town clerk of the town where the property is located. NOTE: Noncompliance with RBES may result in action for damages under 30 V.S.A. § 51. This label does not specify all 2015 RBES requirements. **QUESTIONS? CALL THE VT PUBLIC SERVICE DEPARTMENT: 802-828-2811.**

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Vermont Residential Building Energy Code

Handbook

A Guide to Complying with
Vermont's Residential Building Energy Standards (30 V.S.A. § 51)

Edition 4.2

Base Code Effective March 1, 2015
Stretch Code Effective December 1, 2015

Energy Code Assistance Center
128 Lakeside Ave., Suite 401
Burlington, VT 05401
855-887-0673 ~ *toll free*
802-658-1643 ~ *fax*

Vermont Public Service Department
Planning & Energy Resources Division
112 State Street
Montpelier, VT 05620-2601
802-828-2811

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Basic Requirements – for 2019

1. Air Sealing and Leakage
2. Vapor Retarder
3. Duct Location, Insulation and Sealing
4. HVAC Systems: Efficiency and Balancing
5. Equipment Sizing
6. Programmable Thermostat
7. Fireplaces and Solid Fuel-Burning Appliances
8. Exhaust Fans & Appliances
9. Ventilation
10. Maximum Window U-Factor
11. Electric Systems
12. Mechanical System Piping Insulation and Circulating Hot Water Systems
13. Lighting
14. Heat Pump Supplementary Heat
15. Pools, Hot Tubs and Spas
16. Certification

PLUS Building Envelope Measures

Basic Requirements - Summary

1	**Air Sealing and Leakage**	Seal all joints, access holes and other such openings in the building envelope, as well as connections between building assemblies. Air barrier installation must follow criteria established in Section 2 .1a. Air leakage must be tested, using a blower door test.
2	**Vapor Retarder**	Provide an interior vapor retarder appropriate to wall insulation strategy; refer to Section 2.1c .
3	**Duct Location, Insulation, and Sealing**	No ducts, air handlers, or filter boxes are allowed in unconditioned spaces . Building framing cavities may not be used as ducts or plenums. All ducts, air handlers and filter boxes must be sealed and tested.
4	**HVAC Systems: Efficiency & Balancing**	HVAC heating and cooling systems must comply with minimum federal efficiency standards . All HVAC systems must provide a means of balancing, such as air dampers, adjustable registers or balancing valves .
5	**Equipment Sizing**	Building loads must be calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies . Heating and cooling equipment must be sized in accordance with ACCA Manual S (ref. RBES R403.7).
6	**Programmable Thermostat**	The thermostat controlling the primary heating or cooling of the dwelling must be programmable. Refer to BES R403.1.1 for special cases.

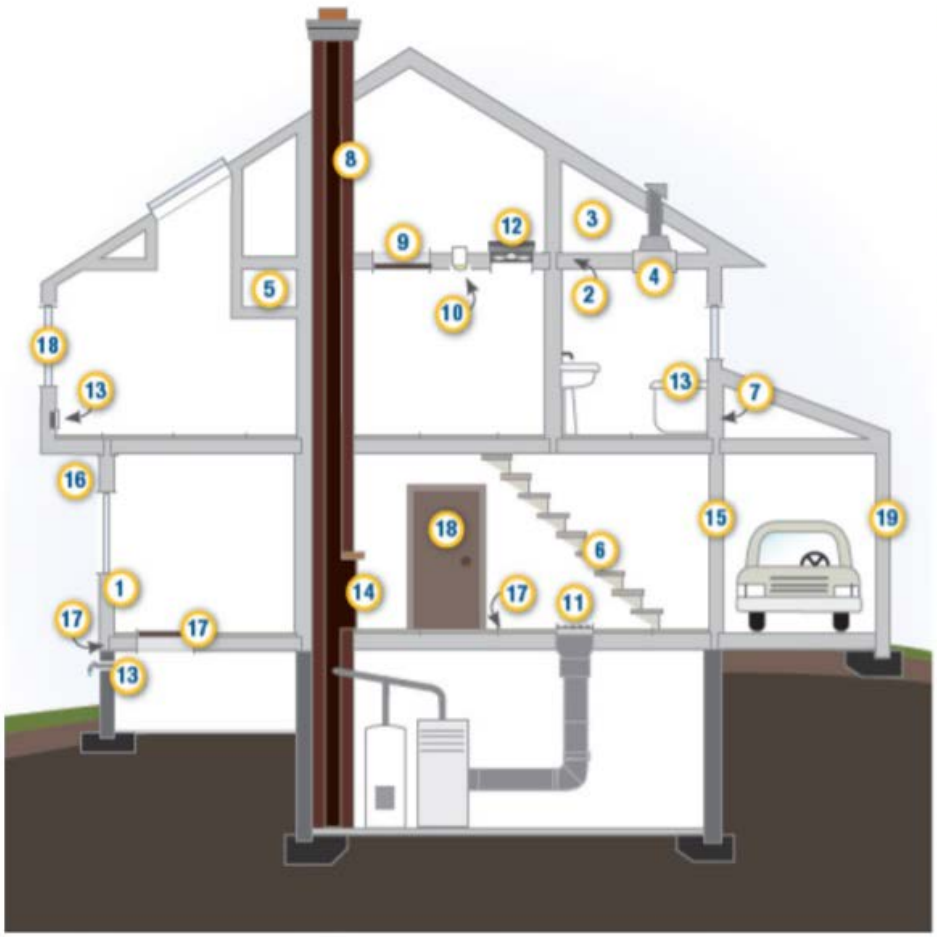
Basic Requirements - Summary

7	**Fireplaces and Solid Fuel-Burning Appliances**	All fireplaces and solid fuel-burning appliances must have tight-fitting, gasketed metal, glass or ceramic doors with compression closure or compression latch system ; exterior air supply (combustion air) must be provided directly from outdoors.
8	**Exhaust Fans and Appliances**	Exhaust dampers are required for kitchen, bath and dryer fans. Makeup air is required for exhaust systems capable of 400 cfm or greater.
9	**Ventilation**	All homes must have an automatically controlled whole house ventilation system. See Chapter 3 for details.
10	**Maximum Fenestration U-Factor**	The area-weighted average maximum fenestration U-factor permitted using trade-offs is 0.30 for windows and 0.55 for skylights .
11	**Electric Systems**	In most cases, each unit of a multi-family dwelling must have a separate electric meter. See Appendix D for exceptions.
12	**Mechanical System Piping Insulation and Circulating Hot Water Systems**	Mechanical system piping capable of carrying fluids above 105°F (41°C) or below 55°F (13°C) must be insulated to a minimum of R-3. Circulating hot water systems must also include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

Basic Requirements - Summary

13	**Lighting**	A minimum of 90% of the lamps in permanently installed lighting fixtures must be high-efficiency lamps.
14	**Heat Pump Supplementary Heat**	Heat pumps shall not have integrated supplementary electric-resistance heat other than that provided for frost control.
15	**Pools, Hot Tubs and Spas**	All swimming pools must have a time clock to control the pump. Heated swimming pools must have both a heater on/off switch in an accessible location and a pool cover. Heaters may not have continuously burning pilot lights.
16	**Certification**	Complete a Vermont Residential Building Energy Standards (RBES) Certificate for each dwelling. Affix the RBES certificate to the electrical panel without covering or obstructing visibility of other labels. Send one copy to the Vermont Public Service Department and one copy to the town clerk of the town in which the property is located.

New Details and Graphics



Air Sealing Trouble Spots

1. Air Barrier and Thermal Barrier Alignment
2. Attic Air Sealing
3. Attic Kneewalls
4. Shaft for Piping or Ducts
5. Dropped Ceiling/Soffit
6. Staircase Framing at Exterior Wall
7. Porch Roof
8. Flue or Chimney Shaft
9. Attic Access
10. Recessed Lighting
11. Ducts
12. Whole-House Fan
13. Exterior Wall Penetrations
14. Fireplace Wall
15. Garage/Living Space Walls
16. Cantilevered Floor
17. Rim Joists, Sill Plate, Foundation, Floor
18. Windows & Doors
19. Common Walls Between Attached Dwelling Units

Figure 4: Building America—air sealing trouble spots

Proposed 2019 RBES Updates

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Code Update Process

- 2018 update process with stakeholder and advisory committee meetings and public review
- http://publicservice.vermont.gov/content/building-energy-standards-update for more details
- Policy Goals
  - Net zero design for new construction by 2030
    - To be discussed via "Code Collaborative in 2020-2021
  - Strategic shift towards:
    - Efficient electric heating
    - Incorporating renewables ("solar ready")
    - Electric vehicle charging capabilities
- Federal pre-emption requirements

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Major Changes for 2019 vs 2015

- Some definitions and other language clarified
- Insulation and fenestration criteria (Base & Stretch)
  - Base Code
    - Prescriptive packages plus required points from list of options based on house size
  - Stretch Code
    - Same approach with more stringent prescriptive packages and more points
- Air Leakage Testing
  - Required blower door testing by certified testers in Base
- Electric resistance heating equipment
- Electric vehicle charging (Base & Stretch)
- HERS (ERI) rating values (Base & Stretch)
- Solar Ready (Stretch)

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TABLE R402.1.2.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT FOR BASE PACKAGES

Component[a]		Package 1 "Standard"	Package 2 "SIPS"	Package 3 "Thick Wall"	Package 4 "Cavity Only"	Package 5 "Log Homes"
Envelope	Ceiling R-Value	R-49[f]	R-28 cont.	R-49[f]	R-60[g] attic / R-49[f] slope	Construct log home to ICC 400-2017 "Standard on the Design and Construction of Log Structures" OR Table R402.1.6
	Wood Frame Wall R-Value	R-20+5[e] **OR** 13+10[e]	R-21 cont.	R-20+12[e]	R-20 cavity	
	Common Wall Insulation	R-10	R-10	R-10	R-10	
	Floor R-Value	R-30	R-30	R-30	R-38	
	Basement/Crawl Space Wall[c] R-Value	R-15 (continuous) **OR** 20 (cavity) **OR** R13+5	R-15 (continuous) **OR** 20 (cavity) **OR** R13+5	R-20 (continuous) **OR** R-13+10[e]	R-20 (continuous) **OR** R-13+10[e]	
	Slab Edge[d] R-Value	R-15, 4ft **OR** R10 perimeter + R-7.5 under entire rest of slab	R-15, 4 ft **OR** R10 perimeter + R-7.5 under entire rest of slab	R-10, 4ft	R-15, 4 ft **OR** R10 perimeter + R-7.5 under entire rest of slab	
	Heated Slab[d] R-Value	R-15 (edge and under)	R-15 (edge and under)	R-15 (edge and under)	R-15 (edge and under)	
	Fenestration[b] (Window and Door) max. U-Value	U-0.30	U-0.30	U-0.30	U-0.28	
	Skylight[b] max. U-Value	U-0.55	U-0.55	U-0.55	U-0.55	
Air Leakage	Air Leakage[i]	≤3.0 ACH50 tested	≤3.0 ACH50 tested	≤3.0 ACH50 tested	≤3.0 ACH50 tested	
Mechanicals	Duct Leakage	Inside thermal boundary	Inside thermal boundary	4 CFM25 per 100 sq. ft. of CFA[k]	Inside thermal boundary	
Lighting	Percent High Efficacy Lamps[l]	90%	90%	90%	100%	

Footnotes for R402.1.2.1

a. *R*-values are minimums. *U*-factors are maximums. Where insulation is installed in a cavity that is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall be not less than the *R*-value specified in the table.
b. The fenestration *U*-factor row excludes skylights.
c. The continuous portion of basement and crawlspace insulation can be met through interior, exterior or combination.
d. "4 ft" can be horizontal or vertical coverage including slab edge. "Edge and under" requires complete coverage. Up to 8 lineal feet of exposed slab edge may be insulated to R-10. "Heated slab" are those with embedded radiation.
e. The first value is cavity insulation, the second value is continuous insulation, so "13+10" means R-13 cavity insulation plus R-10 continuous insulation.
f. Installing R-38 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. (See Section R402.2.1). Multifamily buildings using continuous insulation with a maximum U-factor of 0.023 for the ceiling assembly satisfies this requirement.
g. Installing R-49 over 100 percent of the ceiling area requiring insulation shall be deemed to satisfy the requirement for R-60 insulation wherever the full height of uncompressed R-49 insulation extends over the wall top plate at the eaves. (See Section R402.2.1.)
h. "ACH50" = air changes per hour at 50 Pascals building pressure as measured with a blower door
i. "CFA" = conditioned floor area
j. See Table R402.4.1.1 for further details.

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TABLE R402.1.2.2
REQUIRED POINTS BY BUILDING SIZE

Building Size	Required Points
Multifamily < 2000 square feet average size unit	4 points
<2000 square feet	5 points
2000 to 4000 square feet	7 points
>4000 square feet	10 points

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TABLE R402.1.2.3
POINTS BY COMPONENT

Component		Description	Points
Envelope	Slab	R-10 below entire slab	1
	Walls - Upgraded	Above grade walls R-20+12 (or U-factor maximum 0.033 wall assembly) (Not available for base package 3) **OR**[b]	2
	Walls - High-R	Above grade walls ≥ R-40(cavity + continuous) (or U-factor maximum 0.025 wall assembly)	3
	Ceiling	R-80 attic flat / R-60 sloped, vaulted and cathedral	1
	Windows	Average U-factor ≤ 0.27 **OR**[b]	1
		Average U-factor ≤ 0.22	2
Air Leakage and Ventilation	Pre-Drywall	ACH50 is tested with blower door after full insulation/primary air barrier completion but before insulation is fully enclosed/covered **OR**[b]	1
	Tight	ACH50 ≤ 2.0 and balanced ventilation with ECM[e] fans and ≥ 70% SRE[d] for HRV[c], ≥65% SRE[d] for ERV[c] **OR**[b]	3
	Very Tight	ACH50 ≤ 1.0 and balanced ventilation with ECM[e] fans and ≥ 80% SRE[d] for HRV[c], ≥75% SRE[d] for ERV[c]	4
Heating and Cooling[a]	Basic	ENERGY STAR basic: (1) Gas/propane furnace ≥95 AFUE, Oil furnace ≥85 AFUE, (2) Gas/Propane Boiler ≥90 AFUE, Oil Boiler ≥87 AFUE, (3) Heat pump HSPF ≥9.0; PLUS any AC is SEER ≥14.5 **OR**[b]	1
	Advanced	Whole building heat/cool is (1) NEEP-listed heat pump combination[j], (2) GSHP[i], closed loop and COP ≥ 3.3, (3) ATWHP[f] COP ≥2.5 and 120F design temp, (4) Advanced wood heating system	3

TABLE R402.1.2.3 - POINTS CON'T

Component		Description	Points
Water	Basic	ENERGY STAR basic: Fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for > 55 gal] **OR**[b]	1
	Advanced	ENERGY STAR advanced: Electric [EF or UEF ≥ 2.00 for ≤ 55 gal; EF ≥2.20 for > 55 gal]	2
	Low Flow	All showerheads ≤ 1.75 gpm[g], all lav. faucets ≤ 1.0 gpm[g], and all toilets ≤ 1.28 gpf[h] **OR**[b]	1
	Certified[k]	Certified water efficient design per WERS, WaterSense, or RESNETH2O	2
	Drain Heat Recovery	Drain water heat recovery system on primary showers and tubs	1
	User-Demand	Controlled hot water recirculation system with user-demand via push-button for furthest fixtures	1
Renewables	Solar Ready	Home is Solar Ready per R407.5, **OR**[b]	1
	On-Site Generation	Solar Photovoltaic (PV) (or other on-site renewable energy system), 1 point per 1.5 kW per housing unit of renewable generation on site	1 per 1.5 kW, max. 4
	Solar Hot Water	Solar hot water system designed to meet at least 50% of annual hot water load	2
Other Measures	Monitoring	Install whole-building energy monitoring system, min. 5 circuits and homeowner access to data	1
	EV Ready	Level 2 electric vehicle charger-ready per R407.4	1
	Battery	Min. 6 kWh grid-connected dispatchable demand-response-enabled battery backup	1

Footnotes for R402.1.2.3

a. Heating and cooling system points are only available if all components of primary systems comply

b. "**OR**" indicates that points are not additive; one component OR the following one can be selected, but not both.

c. "H/ERV" = Heat or Energy Recovery Ventilation

d. "SRE" = System Recovery Efficiency

e. "ECM" = Electronically Commutated Motor

f. "ATWHP" = Air-to-Water Heat Pump

g. "gpm" = gallons per minute

h. "gpf" = gallons per flush. Applies to new construction only.

i. "GSHP" = ground-source heat pump

j. https://neep.org/initiatives/high-efficiency-products/emergingtechnologies/ashp/cold-climate-air-source-heat-pump

k. Certification standard as of 1/1/2019 or later. "WERS" = Water Efficiency Rating Score http://www.wers.us/. EPA WaterSense compliance for all water products, https://www.epa.gov/watersense. RESNET Water Energy Rating Index compliant, http://www.resnet.us/professional/about/resnet_to_develop_water_efficiency_rating_system.

l. Points are limited to one per dwelling. Additional Level 2 charging equipment receives no more points.

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Example – Base Code #1 "Standard"

Component	Value
Ceiling R-Value	R-49
Wood Frame Wall R-Value	R-20+5 OR 13+10
Common Wall Insulation	R-10
Floor R-Value	R-30
Basement/Crawl Space Wall R-value	R-15 (continuous) OR 20 (cavity) OR R13+5
Slab Edge R-Value	R-15, 4ft OR R10 perimeter + R-7.5 under entire rest of slab
Heated Slab R-Value	R-15 (edge and under)
Fenestration max. U-Value	U-0.30
Skylight max. U-Value	U-0.55
Air Leakage	≤3.0 ACH50 tested
Duct Leakage	Inside thermal boundary
Percent High Efficacy Lamps	90%

Example – Base Code Points

- 7 Points needed for 2500 sq. ft.

Component		Description	Points
Envelope	Slab	R-10 below entire slab	1
	Walls – Upgraded	Above grade walls R-20+12 (or U-factor maximum 0.033 wall assembly) (Not available for base package 3)	2
	Windows	Average U-factor ≤ 0.27	1
Air Leakage and Ventilation	Pre-Drywall	ACH50 is tested with blower door after full insulation/primary air barrier completion but before insulation is fully enclosed/covered	1
Heating and Cooling[a]	Basic	ENERGY STAR basic: (1) Gas/propane furnace ≥95 AFUE, Oil furnace ≥85 AFUE, (2) Gas/Propane Boiler ≥90 AFUE, Oil Boiler ≥87 AFUE, (3) Heat pump HSPF ≥9.0; PLUS any AC is SEER ≥14.5	1
Water	Basic	ENERGY STAR basic: Fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for > 55 gal]	1

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Example – Base Code #4 "Cavity Only"

Component	Value
Ceiling R-Value	R-60[g] attic / R-49[f] slope
Wood Frame Wall R-Value	R-20 cavity
Common Wall Insulation	R-10
Floor R-Value	R-38
Basement/Crawl Space Wall R-value	R-20 (continuous) **OR** R-13+10[e]
Slab Edge R-Value	R-15, 4 ft **OR** R10 perimeter + R-7.5 under entire rest of slab
Heated Slab R-Value	R-15 (edge and under)
Fenestration max. U-Value	U-0.28
Skylight max. U-Value	U-0.55
Air Leakage	≤3.0 ACH50 tested
Duct Leakage	Inside thermal boundary
Percent High Efficacy Lamps	100%

Example – Base Code Points for Large Home

- 10 Points needed for 4500 sq. ft.

Component		Description	Points
Envelope	Windows	Average U-factor ≤ 0.22	2
Air Leakage and Ventilation	Tight	ACH50 ≤ 2.0 and balanced ventilation with ECM[e] fans and ≥ 70% SRE[d] for HRV[c], ≥65% SRE[d] for ERV[c] **OR**[b]	3
Heating and Cooling[a]	Advanced	Whole building heat/cool is (1) NEEP-listed heat pump combination[j], (2) GSHP[i], closed loop and COP ≥ 3.3, (3) ATWHP[f] COP ≥2.5 and 120F design temp, (4) Advanced wood heating system	3
Water	Advanced	ENERGY STAR advanced: Electric [EF or UEF ≥ 2.00 for ≤ 55 gal; EF ≥2.20 for > 55 gal]	2

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Stretch Code

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Stretch Code Overview

- Precursor of the next base code
- Moving to continuous insulation
- Fewer packages
- More points required
  - Same Points Table as for Base Code
  - Table R402.1.2.3, Points by Component

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Stretch Code

TABLE R407.2.1.1

Component[a]		Package 1	Package 2	Package 3
		"Standard"	"SIPS"	"Thick Wall"
Envelope	Ceiling R-Value	R-60[g] attic / R-49[f] slope	R-36 cont.	R-49[f]
	Wood Frame Wall R-Value	R-20+5[e] **OR** 13+10[e]	R-21 cont.	R-20+12[e]
	Common Wall Insulation	R-10	R-10	R-10
	Floor R-Value	R-30	R-30	R-30
	Basement/Crawl Space Wall[c] R-Value	R-20 (continuous) **OR** R-13+10[e]	R-20 (continuous) **OR** R-13+10[e]	R-20 (continuous) **OR** R-13+10[e]
	Slab Edge[d] R-Value	R-15, 4ft **OR** R10 perimeter + R-7.5 under entire rest of slab	R-15, 4 ft **OR** R10 perimeter + R-7.5 under entire rest of slab	R-15, 4ft **OR** R10 perimeter + R-7.5 under entire rest of slab
	Heated Slab[d] R-Value	R-15 (edge and under)	R-15 (edge and under)	R-15 (edge and under)
	Fenestration[b] (Window and Door) max. U-Value	U-0.28	U-0.2 8	U-0.30
	Skylight[b] max. U-Value	U-0.55	U-0.55	U-0.55
Air Leakage and Ventilation	Air Leakage[i]	≤3.0 ACH50[h] tested	≤3.0 ACH50[h] tested	≤3.0 ACH50[h] tested
	Ventilation	Balanced; ECM[l] fan plus ≥ 70% SRE[k] for HRV[j], ≥ 65% SRE for ERV[j]	Balanced; ECM[l] fan plus ≥ 70% SRE[k] for HRV[j], ≥ 65% SRE for ERV[j]	Balanced; ECM[l] fan plus ≥ 70% SRE[k] for HRV[j], ≥ 65% SRE for ERV[j]
Mechanicals	Duct Leakage	Inside thermal boundary	Inside thermal boundary	Inside thermal boundary
Lighting	Percent High Efficacy Lamps[j]	90%	90%	90%

Stretch Points

TABLE R407.2.1.2
REQUIRED POINTS BY BUILDING SIZE

Building Size	Required Points
Multifamily < 2000 square feet average unit size	6 points
<2000 square feet	7 points
2000 to 4000 square feet	9 points
>4000 square feet	12 points

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Stretch Code TABLE R407.2.1.3
POINTS BY COMPONENT (Same as for Base)

Component		Description	Points
Envelope	Slab	R-10 below entire slab	1
	Walls - Upgraded	Above grade walls R-20+12 (or U-factor maximum 0.033 wall assembly) (Not available for base package 3) **OR**[b]	2
	Walls - High-R	Above grade walls ≥ R-40(cavity + continuous) (or U-factor maximum 0.025 wall assembly)	3
	Ceiling	R-80 attic flat / R-60 sloped, vaulted and cathedral	1
	Windows	Average U-factor ≤ 0.27 **OR**[b]	1
		Average U-factor ≤ 0.22	2
Air Leakage and Ventilation	Pre-Drywall	ACH50 is tested with blower door after full insulation/primary air barrier completion but before insulation is fully enclosed/covered **OR**[b]	1
	Tight	ACH50 ≤ 2.0 and balanced ventilation with ECM[e] fans and ≥ 70% SRE[d] for HRV[c], ≥65% SRE[d] for ERV[c] **OR**[b]	3
	Very Tight	ACH50 ≤ 1.0 and balanced ventilation with ECM[e] fans and ≥ 80% SRE[d] for HRV[c], ≥75% SRE[d] for ERV[c]	4
Heating and Cooling[a]	Basic	ENERGY STAR basic: (1) Gas/propane furnace ≥95 AFUE, Oil furnace ≥85 AFUE, (2) Gas/Propane Boiler ≥90 AFUE, Oil Boiler ≥87 AFUE, (3) Heat pump HSPF ≥9.0; PLUS any AC is SEER ≥14.5 **OR**[b]	1
	Advanced	Whole building heat/cool is (1) NEEP-listed heat pump combination[j], (2) GSHP[i], closed loop and COP ≥ 3.3, (3) ATWHP[f] COP ≥2.5 and 120F design temp, (4) Advanced wood heating system	3

TABLE R407.2.1.3 - POINTS (CONTINUED)

Component		Description	Points
Water	Basic	ENERGY STAR basic: Fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for > 55 gal] **OR**[b]	1
	Advanced	ENERGY STAR advanced: Electric [EF or UEF ≥ 2.00 for ≤ 55 gal; EF ≥2.20 for > 55 gal]	2
	Low Flow	All showerheads ≤ 1.75 gpm[g], all lav. faucets ≤ 1.0 gpm[g], and all toilets ≤ 1.28 gpf[h] **OR**[b]	1
	Certified[k]	Certified water efficient design per WERS, WaterSense, or RESNETH2O	2
	Drain Heat Recovery	Drain water heat recovery system on primary showers and tubs	1
	User-Demand	Controlled hot water recirculation system with user-demand via push-button for furthest fixtures	1
Renewables	Solar Ready	Home is Solar Ready per R407.5, **OR**[b]	1
	On-Site Generation	Solar Photovoltaic (PV) (or other on-site renewable energy system), 1 point per 1.5 kW per housing unit of renewable generation on site	1 per 1.5 kW, max. 4
	Solar Hot Water	Solar hot water system designed to meet at least 50% of annual hot water load	2
Other Measures	Monitoring	Install whole-building energy monitoring system, min. 5 circuits and homeowner access to data	1
	EV Ready	Level 2 electric vehicle charger-ready per R407.4	1
	Battery	Min. 6 kWh grid-connected dispatchable demand-response-enabled battery backup	1

Envelope Differences

Approach		HERS	Savings vs. 2015
Base Code	Packages Only (excluding Points)	70	7%
	Packages + Points	61	19%
Stretch Code	Packages Only (excluding Points)	64	13%
	Packages + Points	54	23%

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Other Code Changes

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Air Leakage Testing for Base Code

- R402.4.1.2 Air Leakage Testing.
  - …Testing and verification shall be conducted by an applicable Building Performance Institutes (BPI) Professional, a Home Energy Rating System (HERS) Energy Rater, HERS Field Inspector, or a Vermont Public Service Department approved air leakage tester
  - Optional reporting in Base, required in Stretch:
    - Report cubic feet per minute at 50 Pascals (CFM50) per square foot of building thermal shell area.
    - Building thermal shell area shall include all six (6) sides of the building.
    - For consistency with CBES and to prepare the market to move to this better metric

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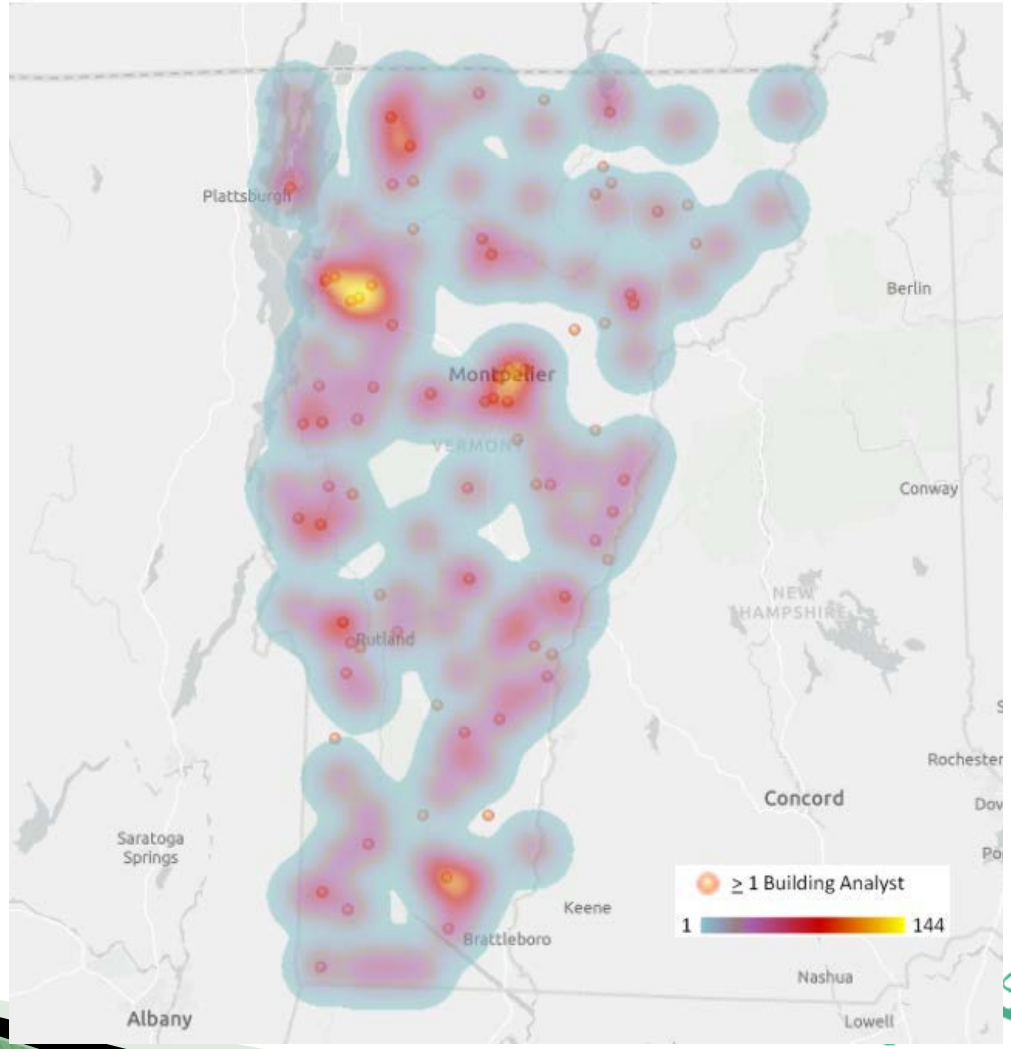
Building Permits & Building Analysts

Building Permits and Building Analysts per Town



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Electric Resistance Heating

R404.2 Electric resistance heating equipment.

Heat pumps having supplementary electric resistance heat shall be certified cold-climate heat pumps only and shall have controls that, except during defrost, prevent supplementary electric heat operation where the heat pump compressor can meet the heating load.

Building heating with electric resistance heating equipment is prohibited.

Exceptions*:

1. Replacement of existing electrical resistance units.
2. Limited areas where other heating sources are cost prohibitive or impractical (e.g., a small interior space such as a bathroom or stairwell, which is distant from the distribution system).
3. Buildings with Cold-Climate Heat Pump(s) as the primary heating system, provided:
   a) The supplemental electric resistance heat is controlled to prevent it from operating at an outside air temperature of 5°F or higher; and
   b) The building has a tested air tightness of ≤ 2.0 ACH50.
4. Multifamily buildings with heating loads ≤ 6.0 Btu/hour/square foot at design temperature.

*Buildings served by the City of Burlington Electric (BED) must also receive approval from BED before installing supplemental electric resistance heating equipment.

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HERS Rating

- R406.4 ERI-based compliance
  - Standards:
    - Base – HERS ("Energy Rating Index" or "ERI") of 61
    - Stretch – HERS (ERI) of 54
    - Based on current HERS software
  - Up to 5 ERI points can be earned with renewables.

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Electric Vehicle Charging

- R404.3 Electric vehicle charging.
- Language from 2015 Stretch is now in Base
  - For multifamily developments of 10 or more dwelling units, 4% of parking spaces shall have a socket capable of providing either a level 1 or level 2 charge.
  - Exemptions:
    1. Parking spaces intended exclusively for storage of vehicles for retail sale or vehicle service.
    2. Parking spaces are separated from the meter by a public right-of-way.
    3. Parking spaces which are limited to parking durations of less than an hour.
    4. The number of parking spaces that are marked for "EV use only" need not exceed the number of EV cars driven by occupants of the building.

- R407.4 Stretch Code
  - For single family housing, one Level 1 parking space is required with accessible socket.
  - Otherwise, same as 404.3 base requirements.

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Solar Ready for Stretch Code

- **R407.5 Solar Ready Zone for Stretch Code**
  - Construction documents need to show
  - Roof area or ground mount minimum areas
  - Roof load documentation
  - Interconnection pathway
  - Electrical service reserved space

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Resources

- Materials posted at http://publicservice.vermont.gov/content/building-energy-standards-update
- Send questions/comments to:
  - PSD.CodeUpdateRes@vermont.gov
  - Logistical comments/questions: info@energyfuturesgroup.com or Gabrielle Stebbins at 802-482-4014
- **Energy Code Assistance Center** (ECAC)
  - 855-887-0673
  - Handbooks, forms, software and other Code-related materials

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Q&A
Best Practices Discussion

- Facilitator: Richard Faesy
- Advisor: Dave Keefe
- Department of Public Service: Barry Murphy and Keith Levenson

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