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# 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

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# 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
- New Buildings Institute
  - Role: Roadmap, stretch code, national expertise
  - Who: Eric Makela, Jim Edelson

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# Presentation Overview

1. Introduction
2. Setting the Stage
3. Roadmap to Net-Zero by 2030
4. Residential 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

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# » Introduction

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# Code Update: Why

- **30 V.S.A. § 51. (Residential Building Energy Standards)**
  - "After January 1, 2011, the commissioner shall ensure that appropriate revisions are made promptly after the issuance of updated standards for residential construction under the IECC."

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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 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.

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# 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

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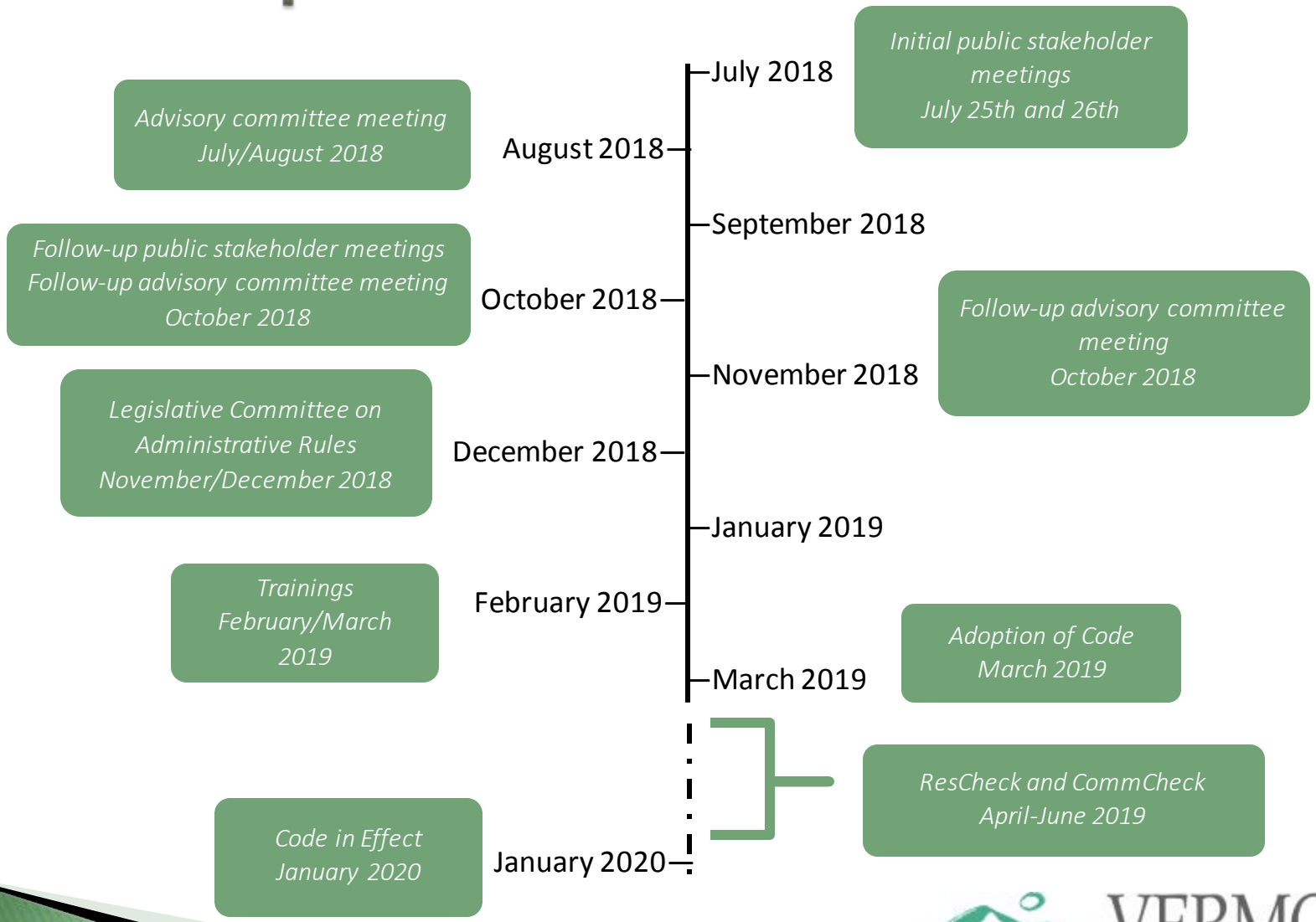
# Code Update: Schedule

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# 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)

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# 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

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# Setting the Stage

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# 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

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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 "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

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# Market Baseline Studies

Residential

- 74% technical compliance in 2011 with 2005 RBES
- A more recent study is in draft form – will be available soon

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# 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

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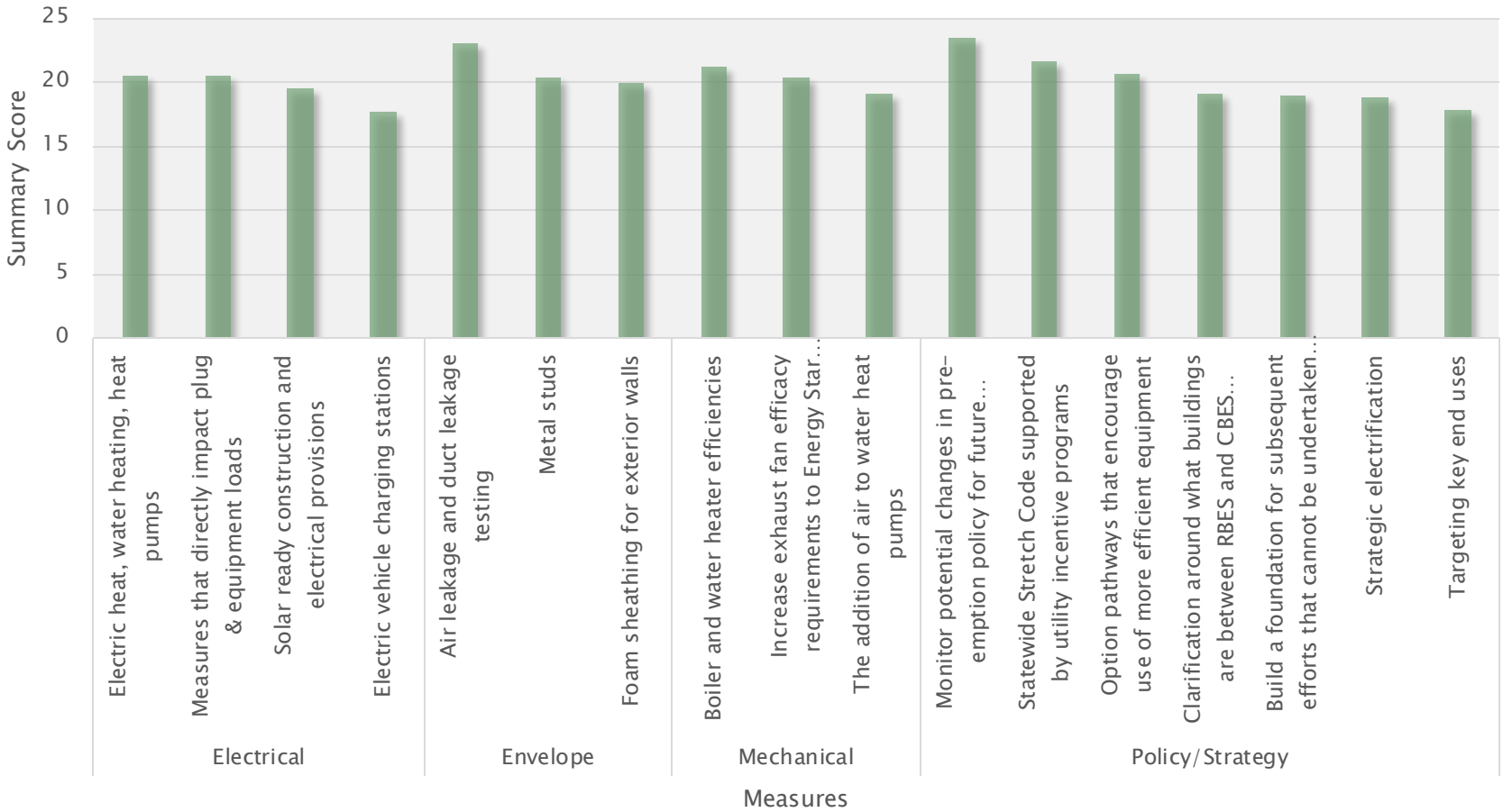
# Residential Measure Scores by Measure Type

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# Proposed Code Basis

- Residential
  1. Starting with 2015 RBES
  2. Adding in IECC 2018 changes (and other changes)
  3. After stakeholder and Advisory Committee process, adding in changes to reach 2019 RBES

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# Roadmap to Net-Zero by 2030

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# 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…

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# 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.

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# 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)*

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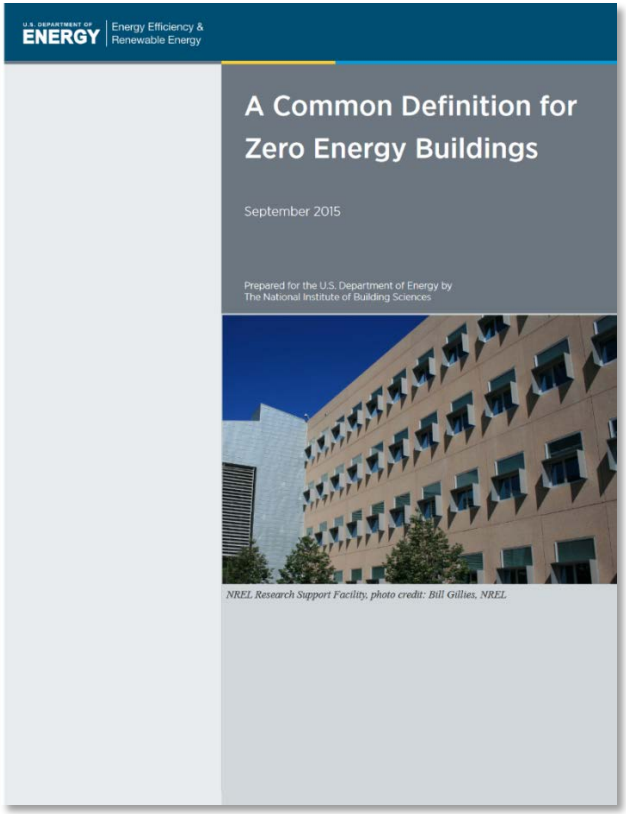
# Zero Energy Definitions

**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).

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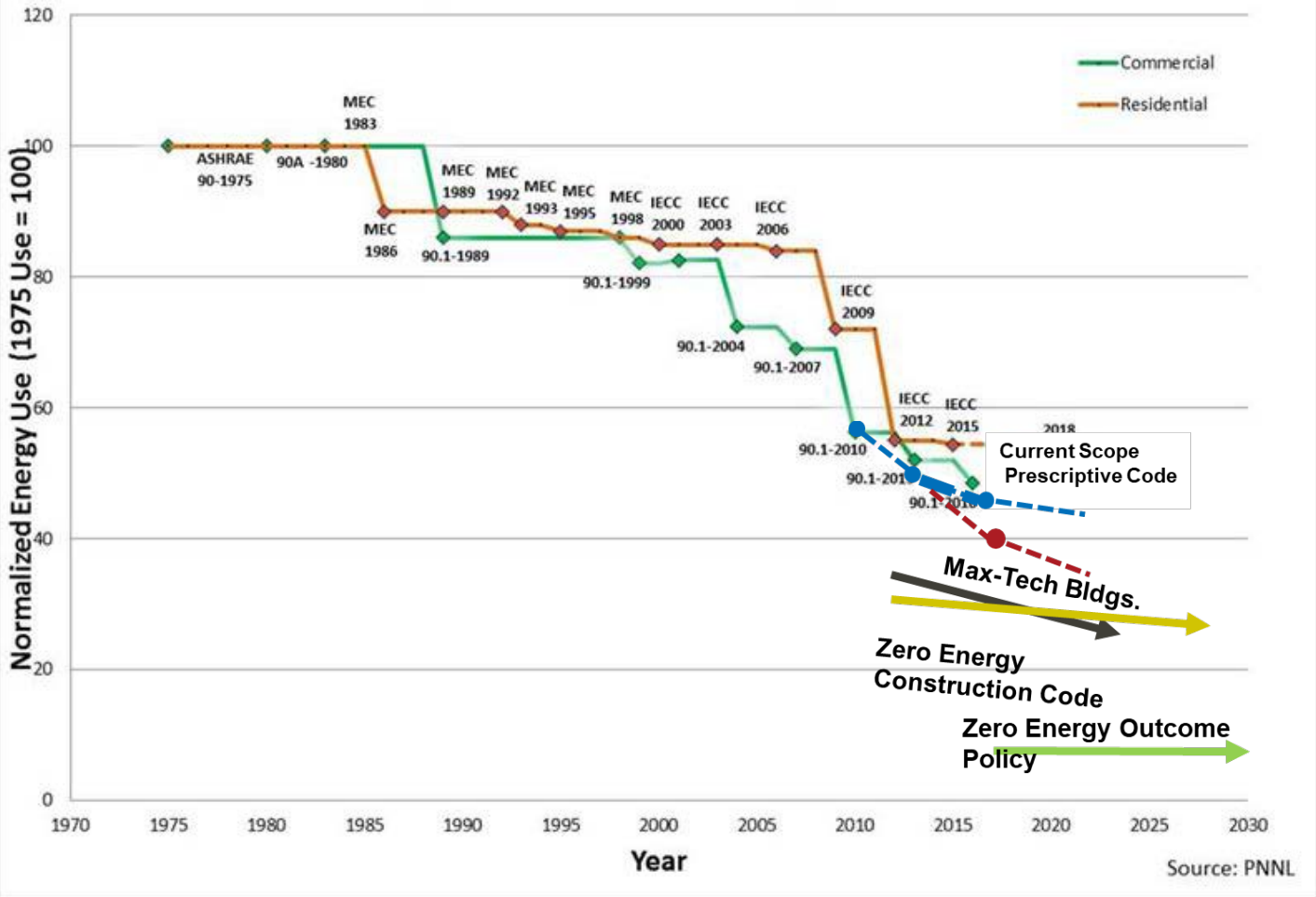
# Improvement in Model Energy Codes

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# 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.

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# 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.)

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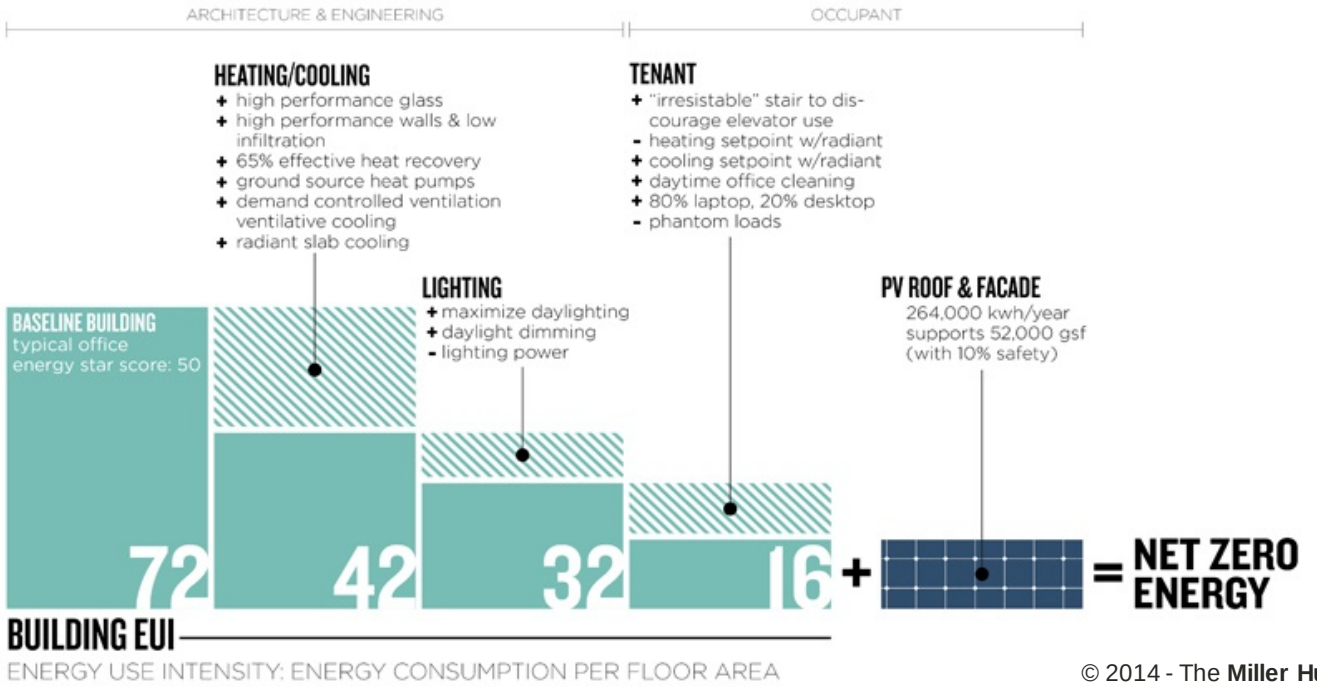
# Potential Approach to Roadmap: Step 2: Set Your Energy Target

- Begin by defining your energy target and solar budget

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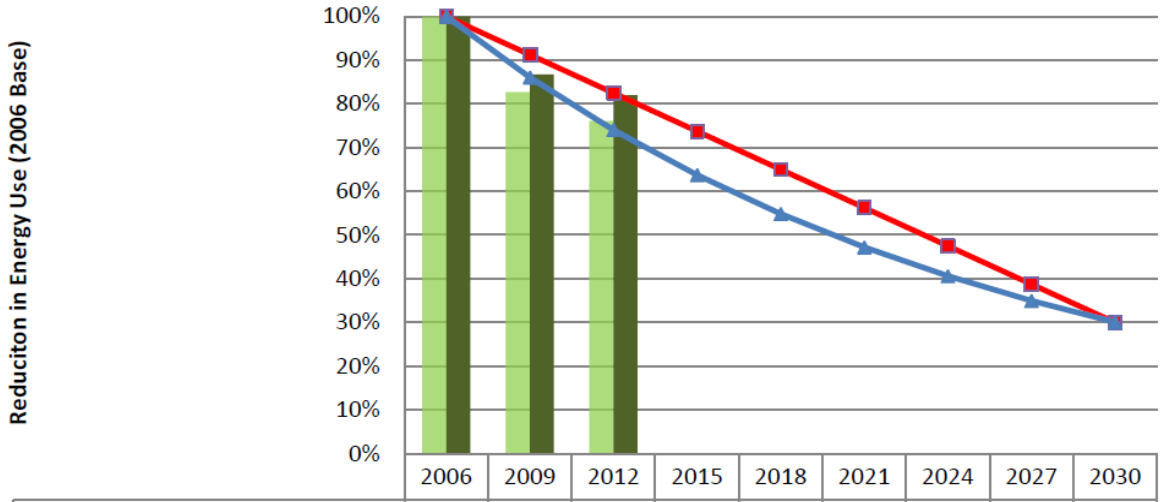
# WA Code Improvement Targets




| | 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% |

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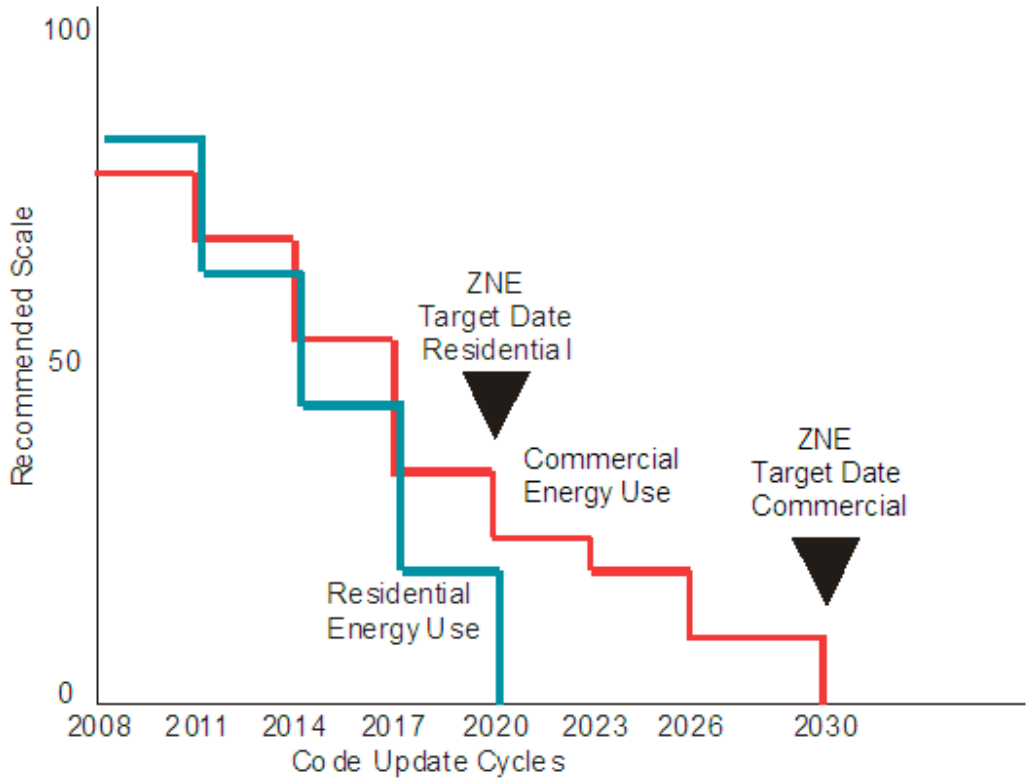
# CA Title 24 – The First ZNE Roadmap

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# 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 |

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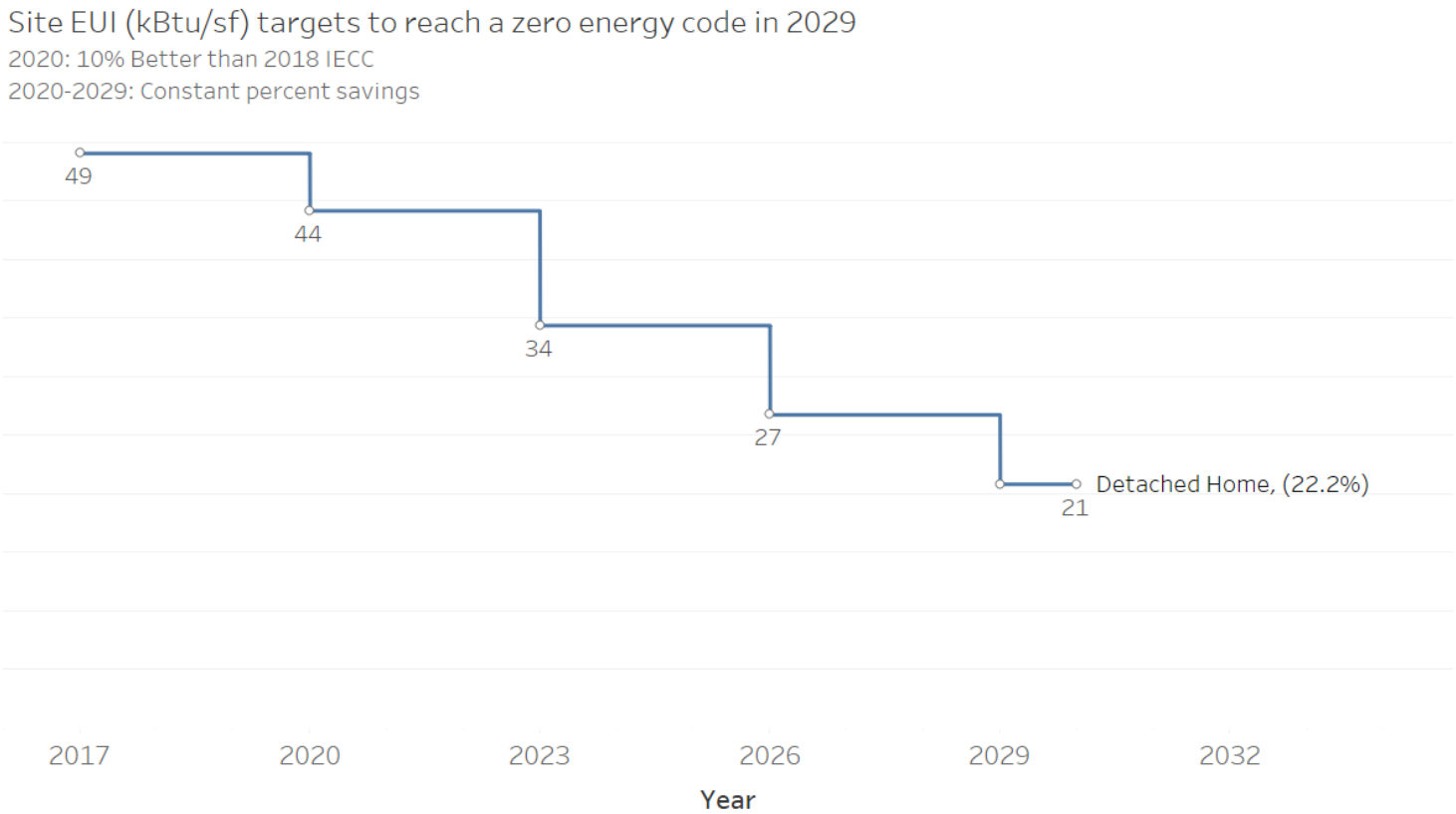
# For discussion:
# Site EUI targets to reach a ZE code in 2029 – Detached Home

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# Potential Target Code Performance Levels

| Constant Percent Savings | |
|---|---|
| Year | Detached Home |
| 2017 | 49.0 |
| 2020 | 44.1 |
| 2023 | 34.3 |
| 2026 | 26.7 |
| 2029 | 20.8 |
| 2020-2029 per cycle savings (%) | 22.2% |

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# Code Landscape

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

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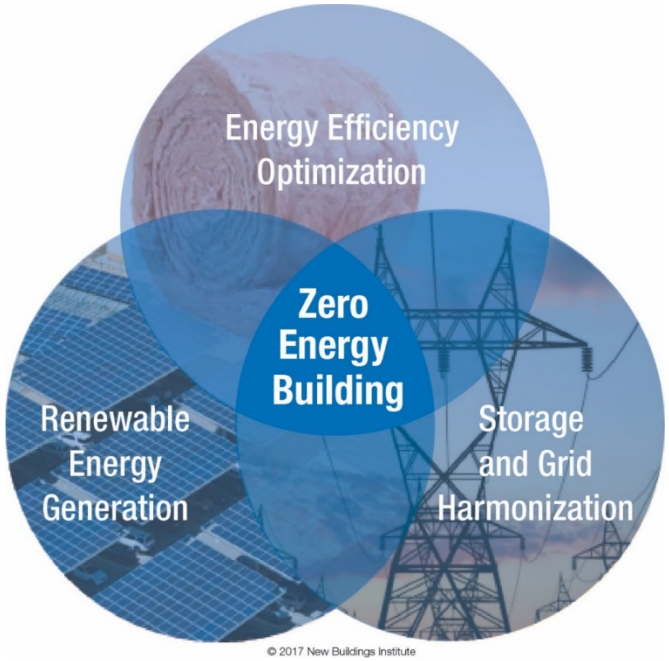
# Complimentary Elements in ZNE

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- Residential

# Compliance Approach

- Federal Preemption Reminder
- 2015 Approach: *Packages* (5 Base, 5 Stretch)
  - Benefits to this approach: Simplicity
  - Drawbacks: Restrictive
- Proposed Approach: *Options* (Points, a la carte)
  - Stretch works the same as Base, except more points chosen
  - Benefits to this approach: Flexibility, decide your own tradeoffs
  - Drawbacks: Learning curve
- 2019 Targets

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# Proposed Approach #1: Packages

- Similar to 2015
- 5 Base Packages, 5 Stretch Packages
- Combinations shown are modeled to be equivalent

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# Proposed Approach #1: Packages

## BASE CODE

| | Package 1 "Base" | Package 2 "2x8 or SPF wall" | Package 3 "SIPS" | Package 4 "Cavity only" | Package 5 "Thick wall" |
|---|---|---|---|---|---|
| Ceiling R-Value | R-49 | R-60 attic / R-49 slope | R-28 cont. | R-60 attic / R-49 slope | R-60 attic / R-49 slope |
| Wood Frame Wall R-Value | R-20+5/ R-13+10 | R-25 cavity | R-21 cont. | R-20 cavity | R-20+12 |
| Floor R-Value | R-30 | R-30 | R-30 | R-30 | R-30 |
| Basement/Crawl Space Wall R-Value | R-15 (cont)/ R-20 (cav) | R-20 (cont)/ R-13+10 | R-15 (cont)/ R-20 (cav) | R-20 (cont) / R-13+10 | R-20 (cont) / R-13+10 |
| Slab Edge R-Value | R-15, 4ft | R-15, 4 ft | R-15, 4 ft | R-15, 4 ft | R-10, 4ft |
| Heated Slab R-Value (Edge and Under) | R-15 | R-15 | R-15 | R-15 | R-15 |
| Window and Door U-Value | 0.30 | 0.22 | 0.30 | 0.30 | 0.30 |
| Skylight U-Value | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 |
| Air Leakage, ACH50 | 3.0 | 3.0 | 3.0 | 2.5 | 3.0 |
| Duct Leakage | Inside thermal boundary | 4 CFM25/100' CFA | Inside thermal boundary | Inside thermal boundary | 4 CFM25/100' CFA |
| Ventilation | Exhaust only allowed | Exhaust only allowed | Exhaust only allowed | Balanced, SRE min. 75% | Exhaust only allowed |
| Lighting | 90% LED | 90% LED | 90% LED | 90% LED | 90% LED |

# Proposed Approach #1: Packages

## STRETCH CODE

| C | Package 1 "Base" | Package 2 "2x8 or SPF wall" | Package 3 "SIPS" | Package 4 | Package 5 "Thick wall" |
|---|---|---|---|---|---|
| Ceiling R-Value | R-60 attic / R-49 slope | R-60 attic / R-49 slope | R-28 cont. | R-49 | R-60 attic / R-49 slope |
| Wood Frame Wall R-Value | R-20+5/ R-13+10 | R-25 cavity | R-21 cont. | R-20+5/ R-13+10 | R-20+12 |
| Floor R-Value | R-30 | R-30 | R-30 | R-30 | R-38 |
| Basement/Crawl Space Wall R-Value | R-20 (cont)/ R-13+10 | R-15 (cont)/ R-20 (cav) | R-20 (cont)/ R-13+10 | R-20 (cont) / R-13+10 | R-20 (cont) / R-13+10 |
| Slab Edge R-Value | R-15, 4ft | R-15, 4 ft | R-15, 4 ft | R-15, 4 ft | R-15, 4ft |
| Heated Slab R-Value (Edge and Under) | R-15 | R-15 | R-15 | R-15 | R-15 |
| Window and Door U-Value | 0.27 | 0.22 | 0.27 | 0.27 | 0.27 |
| Skylight U-Value | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 |
| Air Leakage, ACH50 | 3.0 tested | 2.5 tested | 2.5 tested | 2.5 tested | 2.5 tested |
| Duct Leakage | Inside thermal boundary | Inside thermal boundary | Inside thermal boundary | Inside thermal boundary | Inside thermal boundary |
| Heating / Cooling | ENERGY STAR | ENERGY STAR | ENERGY STAR | ENERGY STAR | NAECA |
| Hot water | ENERGY STAR | ENERGY STAR | ENERGY STAR | ENERGY STAR | NAECA |
| Ventilation | Exhaust only allowed | Balanced, SRE min. 75% | Balanced, SRE min. 75% | Balanced, SRE min. 75% | Balanced, SRE min. 75% |
| Lighting | 90% LED | 90% LED | 90% LED | 90% LED | 90% LED |

# Proposed Approach #2: Options

- New approach to provide more flexibility
- **Does <u>not</u> use Packages shown on previous slides**
- Base and Stretch met through choosing from Options menu after selecting one of two basic assembly packages

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# Proposed Approach #2: Options

## BASE CODE

**Choose one** + **Pick options to get required points**

| | Starter 1 | Starter 2 |
|---|---|---|
| Ceiling R-Value | R-49 | R-60 attic / R-49 slope |
| Wood Frame Wall R-Value | R-20+5/ R-13+10 | R-20 cavity |
| Floor R-Value | R-30 | R-38 |
| Basement/Crawl Space Wall R-Value | R-15 (cont)/ R-20 (cav) | R-20 (cont)/ R-13+10 |
| Slab Edge R-Value | R-15, 4ft | R-15, 4 ft |
| Heated Slab R-Value (Edge and Under) | R-15 | R-15 |
| Window and Door U-Value | 0.30 | 0.30 |
| Skylight U-Value | 0.55 | 0.55 |
| Air Leakage, ACH50 | 3.0 | 3.0 |
| Duct Leakage | 4 CFM25/ 100' CFA | 4 CFM25/ 100' CFA |
| Ventilation | EOV | EOV |
| Lighting | 90% LED | 90% LED |

4 points for < 1500 sf*
5 points for 1500 to < 5000 sf*
8 points for > 5000 sf*

**Points chart on following slide**

*square footage determined by area within thermal envelope (e.g. unfinished basement included)

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# Proposed Points/Options

4 points for < 1500 sf*
5 points for 1500 to < 5000 sf*
8 points for > 5000 sf*

| Category | Points value | |
|---|---|---|
| Envelope – Insulation | 1 | R-10 below entire slab |
| | 1 | AG walls R-21 cont. AND ceiling R-28 cont. (SIP or equiv.) |
| | 2 | AG walls R-20+12 (or equiv. u-factor wall assembly) |
| Envelope – Windows | 1<br>2 | Average u-factor ≤ 0.27 **OR**<br>Average u-factor ≤ 0.22 |
| Air Leakage and Ventilation | 1<br>3 | ACH50 is tested with blower door **OR**<br>ACH50 ≤ 2.0 (tested) and balanced H/ERV with 75% SRE, ECM |
| Heating and Cooling<br>[for all of primary system] | 1<br>3 | ENERGY STAR: (1) Furnace AFUE 95, (2) Gas/Propane Boiler 90 AFUE, Oil Boiler 87 AFUE, (3) Heat pump HSPF 9.0; PLUS any AC is SEER 14.5 **OR**<br>Advanced: Whole house heat/cool is (1) NEEP-listed heat pump combo, (2) GSHP, closed loop and COP 3.3, (3) ATWHP COP 2.5 and 120F design temp |
| | 1 | All HVAC equipment and ductwork completely within air barrier and insulation envelope |
| DHW | 1<br>2 | ENERGY STAR, fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for > 55 gal] **OR**<br>ENERGY STAR, electric [EF or UEF 2.00 for ≤ 55 gal; EF 2.20 for > 55 gal] |
| | 1 | All showerheads ≤ 1.75 gpm, all lav. faucets ≤ 1.0 gpm, and all toilets ≤ 1.28 gpf |
| Strategic electrification | 1<br>1<br>Up to 4 | Home is PV-ready per DOE ZERH guidelines<br>Level 2 electric vehicle charger installed in garage or primary parking area<br>1 pt per 1.5 kW/housing unit of PV generation on site (max 4 pts) |

*square footage determined by area within thermal envelope (unfinished basement included)

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# Examples

| | |
|---|---|
| 4 points for | < 1500 sf |
| 5 points for | 1500 to < 5000 sf |
| 8 points for | > 5000 sf |

1. 1200 sf home with R-20+5 walls. You need 4 pts. Here are some ways to get there:
   - Blower door test (1 pt) + R-10 under slab (1 pt) + ENERGY STAR furnace (1 pt) and ENERGY STAR hot water (1pt)
   - Install 0.27 windows (1 pt) + heat pump water heater (2 pt) + all HVAC/ductwork in thermal envelope (1 pt)
   - Install 4.5 kW of PV on roof (3 pt) + 0.27 windows (1 pt)

2. 3500 sf home with R-20 walls. You need 5 pts. Here are some ways to get there:
   - Blower door test (1 pt) + ENERGY STAR furnace and water heater (2 pt) + 0.27 windows (1 pt) + all HVAC and ductwork in thermal envelope (1 pt)
   - Install HRV and test house to ACH50 $\leq$ 2.0 (3 pt) + ENERGY STAR furnace and water heater (2 pt)
   - EV charger (1 pt) + 4.5 kW of PV in backyard (3 pt) + blower door test (1 pt)

* The above examples are for illustrative purposes only. There are any number of measure combinations to reach the point requirements.

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# Proposed Approach #2: Options

## STRETCH CODE

**Choose one** + **Pick options to get required points**

| | Starter 1 | Starter 2 |
|---|---|---|
| Ceiling R-Value | R-49 | R-60 attic / R-49 slope |
| Wood Frame Wall R-Value | R-20+5/ R-13+10 | R-20 cavity |
| Floor R-Value | R-30 | R-38 |
| Basement/Crawl Space Wall R-Value | R-15 (cont)/ R-20 (cav) | R-20 (cont)/ R-13+10 |
| Slab Edge R-Value | R-15, 4ft | R-15, 4 ft |
| Heated Slab R-Value (Edge and Under) | R-15 | R-15 |
| Window and Door U-Value | 0.30 | 0.30 |
| Skylight U-Value | 0.55 | 0.55 |
| Air Leakage, ACH50 | 3.0 | 3.0 |
| Duct Leakage | 4 CFM25/ 100' CFA | 4 CFM25/ 100' CFA |
| Ventilation | EOV | EOV |
| Lighting | 90% LED | 90% LED |

| | Base | Stretch |
|---|---|---|
| < 1500 sf | 4 | 5 |
| 1500 to < 5000 sf | 5 | 7 |
| > 5000 sf | 8 | 10 |

*square footage determined by area within thermal envelope (e.g. unfinished basement included)

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# Examples [Stretch]

| | |
|---|---|
| 5 points for | < 1500 sf |
| 7 points for | 1500 to < 5000 sf |
| 10 points for | > 5000 sf |

1. 1200 sf home with R-20+5 walls. You need 5 pts. Here are some ways to get there:
   - Blower door test (1 pt) + R-10 under slab (1 pt) + ENERGY STAR furnace (1 pt) and ENERGY STAR hot water (1pt) + **0.27 windows (1 pt)**
   - Install 0.27 windows (1 pt) + heat pump water heater (2 pt) + all HVAC/ductwork in thermal envelope (1 pt) + **Level 2 charger (1 pt)**
   - Install 4.5 kW of PV on roof (3 pt) + 0.27 windows (1 pt) + **blower door test (1 pt)**

2. 3500 sf home with R-20 walls. You need 7 pts. Here are some ways to get there:
   - Blower door test (1 pt) + ENERGY STAR ~~furnace and~~ water heater (1 pt) + 0.27 windows (1 pt) + all HVAC and ductwork in thermal envelope (1 pt) + **high efficiency heat pump (3 pt)**
   - Install HRV and test house to ACH50 ≤ 2.0 (3 pt) + ENERGY STAR furnace and water heater (2 pt) + **all HVAC/ductwork in thermal envelope (1 pt) + 0.27 windows**
   - EV charger (1 pt) + 4.5 kW of PV in backyard (3 pt) + blower door test (1 pt) + **heat pump water heater (2 pt)**

* The above examples are for illustrative purposes only. There are any number of measure combinations to reach the point requirements.

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# Other Measures to Address

| | |
|---|---|
| Air leakage and duct testing | Clarify how measured, whether required |
| Ventilation alternatives | Add flexibility by considering *addition* of BSC 01 and Passive House standards to existing language; add text to allow demand-controlled systems; clarify ASHRAE 62.2 version and whether whole standard applies or just flow rate |
| Vapor retarder language | Clarify/update; consider adding flexibility re: smart/adaptive vapor retarders; more education in Code Handbook on situations to avoid |
| Window requirement | Clarify u-factor per IECC 2018 |
| Lighting | Clarify 90% and efficacy requirements per IECC 2018 |
| Combustion equipment (wood stoves) | Clarify requirement on doors and outdoor combustion air |
| Exhaust fan efficiency | Clarify requirement per IECC 2018 |
| EV charging | Level 1 as Stretch requirement, Level 2 option pathway for Base/Stretch; clarify for MF and common parking areas |
| Residential vs. commercial | Clarify in Code Handbook |
| Electric heat | Clarify requirement; ref: Burlington code language |
| Programmable thermostats | Update language to accommodate cold climate heat pump controls |
| Air barrier / insulation | Update language per IECC 2018 |
| Resiliency | Explore language |

# Stakeholder Discussion –

- Residential

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# Discussion – Compliance Approach

- 2015 Approach: *Packages* (5 Base, 5 Stretch)
  - Benefits to this approach: Simplicity
  - Drawbacks: Restrictive

**Vs.**

- Proposed Approach: *Options* (Points, a la carte)
  - Stretch works the same as Base, except more points chosen
  - Benefits to this approach: Flexibility, decide your own tradeoffs
  - Drawbacks: Learning curve

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# Discussion – Proposed Approach #1: Packages

## BASE CODE

| | Package 1 "Base" | Package 2 "2x8 or SPF wall" | Package 3 "SIPS" | Package 4 "Cavity only" | Package 5 "Thick wall" |
|---|---|---|---|---|---|
| Ceiling R-Value | R-49 | R-60 attic / R-49 slope | R-28 cont. | R-60 attic / R-49 slope | R-60 attic / R-49 slope |
| Wood Frame Wall R-Value | R-20+5/ R-13+10 | R-25 cavity | R-21 cont. | R-20 cavity | R-20+12 |
| Floor R-Value | R-30 | R-30 | R-30 | R-30 | R-30 |
| Basement/Crawl Space Wall R-Value | R-15 (cont)/ R-20 (cav) | R-20 (cont)/ R-13+10 | R-15 (cont)/ R-20 (cav) | R-20 (cont) / R-13+10 | R-20 (cont) / R-13+10 |
| Slab Edge R-Value | R-15, 4ft | R-15, 4 ft | R-15, 4 ft | R-15, 4 ft | R-10, 4ft |
| Heated Slab R-Value (Edge and Under) | R-15 | R-15 | R-15 | R-15 | R-15 |
| Window and Door U-Value | 0.30 | 0.22 | 0.30 | 0.30 | 0.30 |
| Skylight U-Value | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 |
| Air Leakage, ACH50 | 3.0 | 3.0 | 3.0 | 2.5 | 3.0 |
| Duct Leakage | Inside thermal boundary | 4 CFM25/100' CFA | Inside thermal boundary | Inside thermal boundary | 4 CFM25/100' CFA |
| Ventilation | Exhaust only allowed | Exhaust only allowed | Exhaust only allowed | Balanced, SRE min. 75% | Exhaust only allowed |
| Lighting | 90% LED | 90% LED | 90% LED | 90% LED | 90% LED |

# Discussion – Proposed Approach #1: Packages

## STRETCH CODE

| | Package 1a "Base" | Package 1b "Base" | Package 2 "2x8 or SPF wall" | Package 3 "SIPS" | Package 5 "Thick wall" |
|---|---|---|---|---|---|
| Ceiling R-Value | R-60 attic / R-49 slope | R-49 | R-60 attic / R-49 slope | R-28 cont. | R-60 attic / R-49 slope |
| Wood Frame Wall R-Value | R-20+5/ R-13+10 | R-20+5/ R-13+10 | R-25 cavity | R-21 cont. | R-20+12 |
| Floor R-Value | R-30 | R-30 | R-30 | R-30 | R-38 |
| Basement/Crawl Space Wall R-Value | R-20 (cont)/ R-13+10 | R-20 (cont) / R-13+10 | R-15 (cont)/ R-20 (cav) | R-20 (cont)/ R-13+10 | R-20 (cont) / R-13+10 |
| Slab Edge R-Value | R-15, 4ft | R-15, 4 ft | R-15, 4 ft | R-15, 4 ft | R-15, 4ft |
| Heated Slab R-Value (Edge and Under) | R-15 | R-15 | R-15 | R-15 | R-15 |
| Window and Door U-Value | 0.27 | 0.27 | 0.22 | 0.27 | 0.27 |
| Skylight U-Value | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 |
| Air Leakage, ACH50 | 3.0 tested | 2.5 tested | 2.5 tested | 2.5 tested | 2.5 tested |
| Duct Leakage | Inside thermal boundary | Inside thermal boundary | Inside thermal boundary | Inside thermal boundary | Inside thermal boundary |
| Heating / Cooling | ENERGY STAR | ENERGY STAR | ENERGY STAR | ENERGY STAR | Fed. min. |
| Hot water | ENERGY STAR | ENERGY STAR | ENERGY STAR | ENERGY STAR | Fed. min. |
| Ventilation | Exhaust only allowed | Balanced, SRE min. 75% | Balanced, SRE min. 75% | Balanced, SRE min. 75% | Balanced, SRE min. 75% |
| Lighting | 90% LED | 90% LED | 90% LED | 90% LED | 90% LED |

# Discussion – Proposed Approach #2: Options

## BASE CODE

**Choose one** + **Pick options to get required points**

| | Starter 1 | Starter 2 |
|---|---|---|
| Ceiling R-Value | R-49 | R-60 attic / R-49 slope |
| Wood Frame Wall R-Value | R-20+5/ R-13+10 | R-20 cavity |
| Floor R-Value | R-30 | R-38 |
| Basement/Crawl Space Wall R-Value | R-15 (cont)/ R-20 (cav) | R-20 (cont)/ R-13+10 |
| Slab Edge R-Value | R-15, 4ft | R-15, 4 ft |
| Heated Slab R-Value (Edge and Under) | R-15 | R-15 |
| Window and Door U-Value | 0.30 | 0.30 |
| Skylight U-Value | 0.55 | 0.55 |
| Air Leakage, ACH50 | 3.0 | 3.0 |
| Duct Leakage | 4 CFM25/ 100' CFA | 4 CFM25/ 100' CFA |
| Ventilation | EOV | EOV |
| Lighting | 90% LED | 90% LED |

4 points for < 1500 sf*
5 points for 1500 to < 5000 sf*
8 points for > 5000 sf*

**Points chart on following slide**

*square footage determined by area within thermal envelope (e.g. unfinished basement included)

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# Discussion – Proposed Points/Options

4 points for < 1500 sf*
5 points for 1500 to < 5000 sf*
8 points for > 5000 sf*

| Category | Points value | |
|---|---|---|
| Envelope – Insulation | 1 | R-10 below entire slab |
| | 1 | AG walls R-21 cont. AND ceiling R-28 cont. (SIP or equiv.) |
| | 2 | AG walls R-20+12 (or equiv. u-factor wall assembly) |
| Envelope – Windows | 1<br>2 | Average u-factor ≤ 0.27 **OR**<br>Average u-factor ≤ 0.22 |
| Air Leakage and Ventilation | 1<br>3 | ACH50 is tested with blower door **OR**<br>ACH50 ≤ 2.0 (tested) and balanced H/ERV with 75% SRE, ECM |
| Heating and Cooling<br>[for all of primary system] | 1<br>3 | ENERGY STAR: (1) Furnace AFUE 95, (2) Gas/Propane Boiler 90 AFUE, Oil Boiler 87 AFUE, (3) Heat pump HSPF 9.0; PLUS any AC is SEER 14.5 **OR**<br>Advanced: Whole house heat/cool is (1) NEEP-listed heat pump combo, (2) GSHP, closed loop and COP 3.3, (3) ATWHP COP 2.5 and 120F design temp |
| | 1 | All HVAC equipment and ductwork completely within air barrier and insulation envelope |
| DHW | 1<br>2 | ENERGY STAR, fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for > 55 gal] **OR**<br>ENERGY STAR, electric [EF or UEF 2.00 for ≤ 55 gal; EF 2.20 for > 55 gal] |
| | 1 | All showerheads ≤ 1.75 gpm, all lav. faucets ≤ 1.0 gpm, and all toilets ≤ 1.28 gpf |
| Strategic electrification | 1<br>1<br>Up to 4 | Home is PV-ready per DOE ZERH guidelines<br>Level 2 electric vehicle charger installed in garage or primary parking area<br>1 pt per 1.5 kW/housing unit of PV generation on site (max 4 pts) |

*square footage determined by area within thermal envelope (unfinished basement included)

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# Discussion – Proposed Approach #2: Options

## STRETCH CODE

**Choose one** + **Pick options to get required points**

| | Starter 1 | Starter 2 |
|---|---|---|
| Ceiling R-Value | R-49 | R-60 attic / R-49 slope |
| Wood Frame Wall R-Value | R-20+5/ R-13+10 | R-20 cavity |
| Floor R-Value | R-30 | R-38 |
| Basement/Crawl Space Wall R-Value | R-15 (cont)/ R-20 (cav) | R-20 (cont)/ R-13+10 |
| Slab Edge R-Value | R-15, 4ft | R-15, 4 ft |
| Heated Slab R-Value (Edge and Under) | R-15 | R-15 |
| Window and Door U-Value | 0.30 | 0.30 |
| Skylight U-Value | 0.55 | 0.55 |
| Air Leakage, ACH50 | 3.0 | 3.0 |
| Duct Leakage | 4 CFM25/ 100' CFA | 4 CFM25/ 100' CFA |
| Ventilation | EOV | EOV |
| Lighting | 90% LED | 90% LED |

| | Base | Stretch |
|---|---|---|
| < 1500 sf | 4 | 5 |
| 1500 to < 5000 sf | 5 | 7 |
| > 5000 sf | 8 | 10 |

*square footage determined by area within thermal envelope (e.g. unfinished basement included)

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# Discussion – Other Measures to Address

| | |
|---|---|
| Air leakage and duct testing | Clarify how measured, whether required |
| Ventilation alternatives | Add flexibility by considering *addition* of BSC 01 and Passive House standards to existing language; add text to allow demand-controlled systems; clarify ASHRAE 62.2 version and whether whole standard applies or just flow rate |
| Vapor retarder language | Clarify/update; consider adding flexibility re: smart/adaptive vapor retarders; more education in Code Handbook on situations to avoid |
| Window requirement | Clarify u-factor per IECC 2018 |
| Lighting | Clarify 90% and efficacy requirements per IECC 2018 |
| Combustion equipment (wood stoves) | Clarify requirement on doors and outdoor combustion air |
| Exhaust fan efficiency | Clarify requirement per IECC 2018 |
| EV charging | Level 1 as Stretch requirement, Level 2 option pathway for Base/Stretch; clarify for MF and common parking areas |
| Residential vs. commercial | Clarify in Code Handbook |
| Electric heat | Clarify requirement; ref: Burlington code language |
| Programmable thermostats | Update language to accommodate cold climate heat pump controls |
| Air barrier / insulation | Update language per IECC 2018 |
| Resiliency | Explore language |

# Discussion – Air Leakage and Duct Testing

- Should performance testing be required?
- Blower door and duct testing?
- Interest, capacity and capability?
  - Building Performance Professionals Association letter and survey results
    - >100 certified professionals
    - 26 survey responses all confirmed interest
  - Efficiency Vermont letter of support
- Building permits and building analysts seem to generally align

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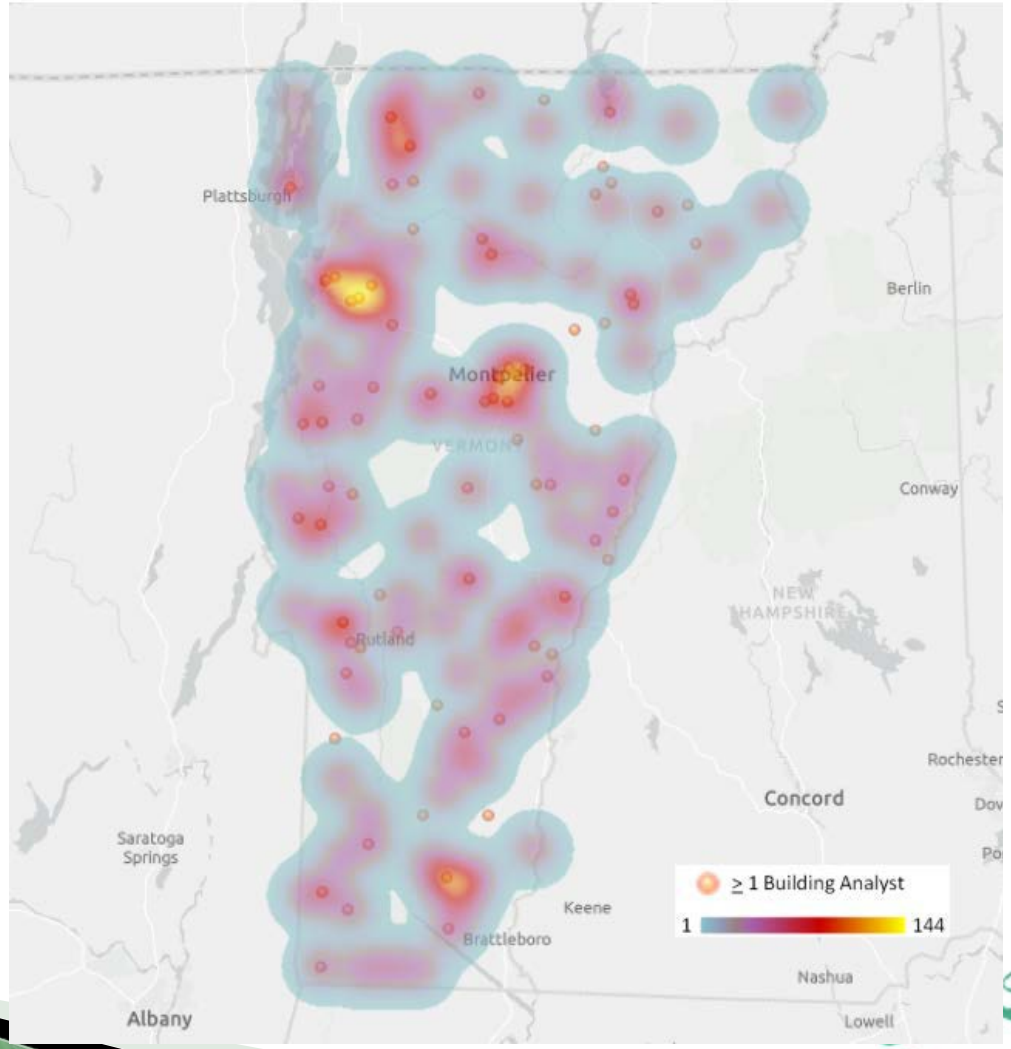
# Building Permits & Building Analysts

Building Permits and Building Analysts per Town

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# Discussion – Ventilation

- Add flexibility by considering *addition* of Building Science Corp 01 and Passive House standards to existing language;
- Add text to allow demand-controlled systems;
- Clarify ASHRAE 62.2 version and whether whole standard applies or just flow rate

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# Discussion – Vapor Retarder Language

- Clarify/update;
- Consider adding flexibility re: smart/adaptive vapor retarders;
- More education in Code Handbook on situations to avoid

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# Discussion – Windows

- Clarify u-factor per IECC 2018
- Max u-factor would now be 0.30
- **R402.3.1 *U*-factor.**
  An area-weighted average of fenestration products shall be permitted to satisfy the *U*-factor requirements.

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# Discussion – Lighting

- Clarify 90% and efficacy requirements per IECC 2018
- **R404.1 Lighting equipment (Mandatory).** Not less than 90 percent of the permanently installed lighting fixtures shall contain only high-efficacy lamps.

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# Discussion – Wood Stoves

- Clarify requirement on doors and outdoor combustion air

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# Discussion – Exhaust Fans Efficacy

- Update the requirements to the latest Energy Star requirement Version 4.0.
- Table R403.6.1 Whole House Mechanical System Efficacy

| FAN LOCATION | AIR FLOW RATE MINIMUM (CFM) | MINIMUM EFFICACY LEVEL (CFM/W)* | AIR FLOW RATE MAXIMUM (CFM) |
|---|---|---|---|
| Range Hoods | Any | 2.8 | Any |
| Bathroom and Utility Room Fans | 10 | ~~1.4~~ 2.8 | 89 |
| Bathroom and Utility Room Fans | 90 | ~~2.8~~ 3.5 | 200 |
| Bathroom and Utility Room Fans | 201 | ~~2.8~~ 4 | Any |
| In-Line (Single-Port & Multi-Port) Fans | Any | ~~2.8~~ 3.8 | Any |
| HRV or ERV | Any | 1.2 | Any |

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# Discussion – EV Charging

- Currently: Level 1 requirements for 10+ units for multi-family
- What is a reasonable increase?
- Potentially: For Stretch, a Level 2 (240 V) charger could receive 1 point via the options pathway?
- Or, is "Level 2 ready", enough, for stretch?
- Discuss multi-family and common parking areas

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# Discussion – Residential vs. Commercial

- Clarify delineations between building types

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# Discussion – Electric Heat

- Clarify Burlington code language

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# Discussion – Programmable Thermostats

- Update language to accommodate cold climate heat pump controls

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# Discussion – Air barrier / insulation

Update language per IECC 2018 (R402.4.1.1 on pR-34):

- Recessed lighting: Recessed lighting fixtures installed in the building thermal envelope shall be sealed to the finished surface.
- HVAC register boots: HVAC supply and return register boots that penetrate building thermal envelope shall be sealed to the subfloor, wall covering or ceiling penetrated by the boot

Other

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# Discussion – Resiliency

- Is this necessary in to include?
  - or
- Is it too soon to try to address for 2019?

- For example, what do stakeholders think "resiliency" means?
  - Storage?
  - Building durability?
  - Other?

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# 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<br>12:30 – 3:30 commercial<br>Lunch will be provided | Hartford Town Hall (& online)<br>Room 2, 171 Bridge Street<br>White River Junction |
| Public Stakeholder Meeting | July 26th | 9:00 – 12:00 residential<br>12:30 – 3:30 commercial<br>Lunch will be provided | Burlington Electric Department Auditorium (& online)<br>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) | | |

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

# » Q&A

- Send future questions/comments to:
  - Residential focus: PSD.CodeUpdateRes@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

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