



Vermont Codes Update Webinar

July 19, 2018
2:00 – 4:00 p.m.

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



Code Update: Who

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

Presentation Overview

1. Introduction (15 minutes)
2. Setting the Stage (10 minutes)
3. Roadmap to Net-Zero by 2030 (20 minutes)
4. Residential (30 minutes)
5. Commercial (30 minutes)
6. Q&A (15 minutes)

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

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

Please ask clarifying questions during the presentation by typing in your question. Please hold other questions until the end of the presentation.

»» Introduction

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.”
- ▶ **30 V.S.A. § 52. (Commercial Building Energy Standards)**
 - “At least every three years after January 1, 2011, the commissioner of public service shall amend and update the CBES by means of administrative rules adopted in accordance with 3 V.S.A. chapter 25. The commissioner shall ensure that appropriate revisions are made promptly after the issuance of updated standards for commercial construction under the IECC or ASHRAE/ANSI/IESNA standard 90.1, whichever provides the greatest level of energy savings.”

Code Update: Framework

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

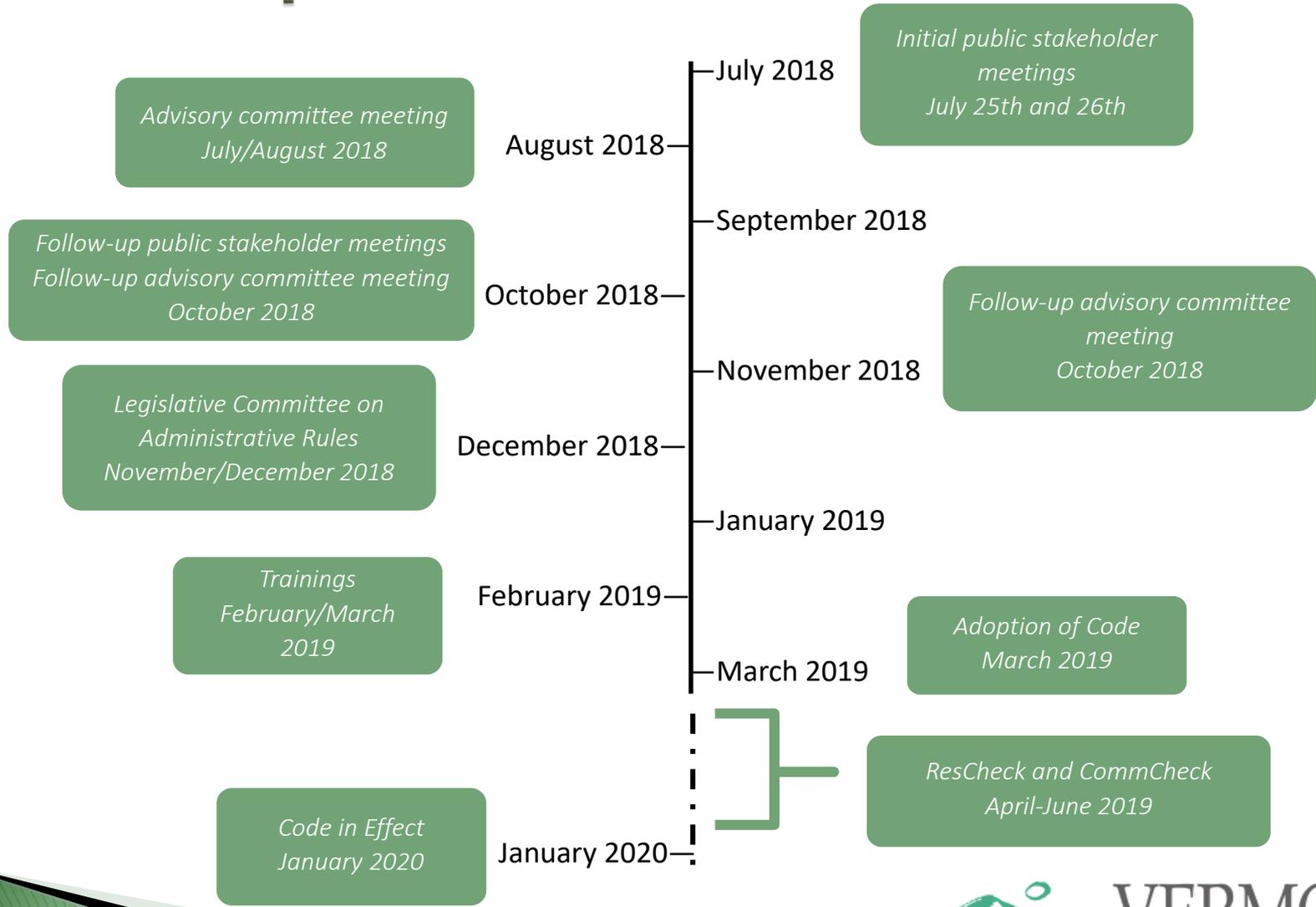
- ▶ 10 V.S.A. § 581 (building efficiency goals)
- ▶ 10 V.S.A. § 578 (greenhouse gas reduction)
- ▶ 30 V.S.A. § 8002–8005 (Renewable Energy Standard)
 - Additional net-metering (mostly solar)
 - Tier Three (requirement to shift from fossil fuels to electricity)
- ▶ Comprehensive Energy Plan (all new buildings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

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

Code Update: Schedule



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)

Code Update: Rulemaking Process

~ November 2018 ~ March 2019

- ▶ Pre-filing with “Interagency Committee on Administrative Rules” (ICAR)
- ▶ File proposed rule with Secretary of State
- ▶ Public hearing and comment period
- ▶ File final proposed rule
- ▶ Response to “Legislative Committee on Administrative Rules” (LCAR)
- ▶ Final adopted rule
 - Final “adoption date” is the date the language is filed
 - “Effective date” no less than 3 months after adoption

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

»» Setting the Stage

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

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

Market Baseline Studies

Commercial

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

Residential

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

Scoring of Potential Measures

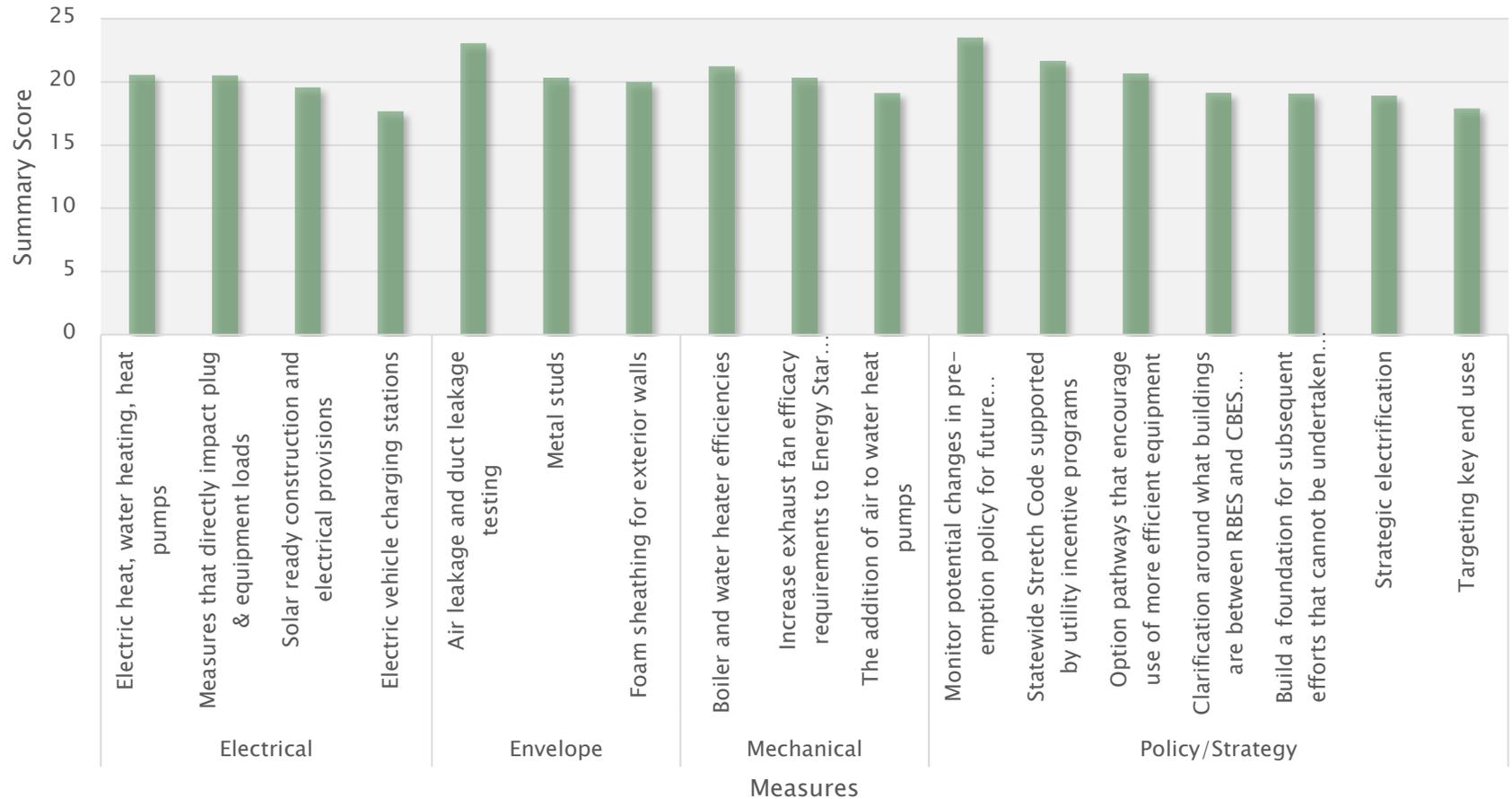
▶ Process

- 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

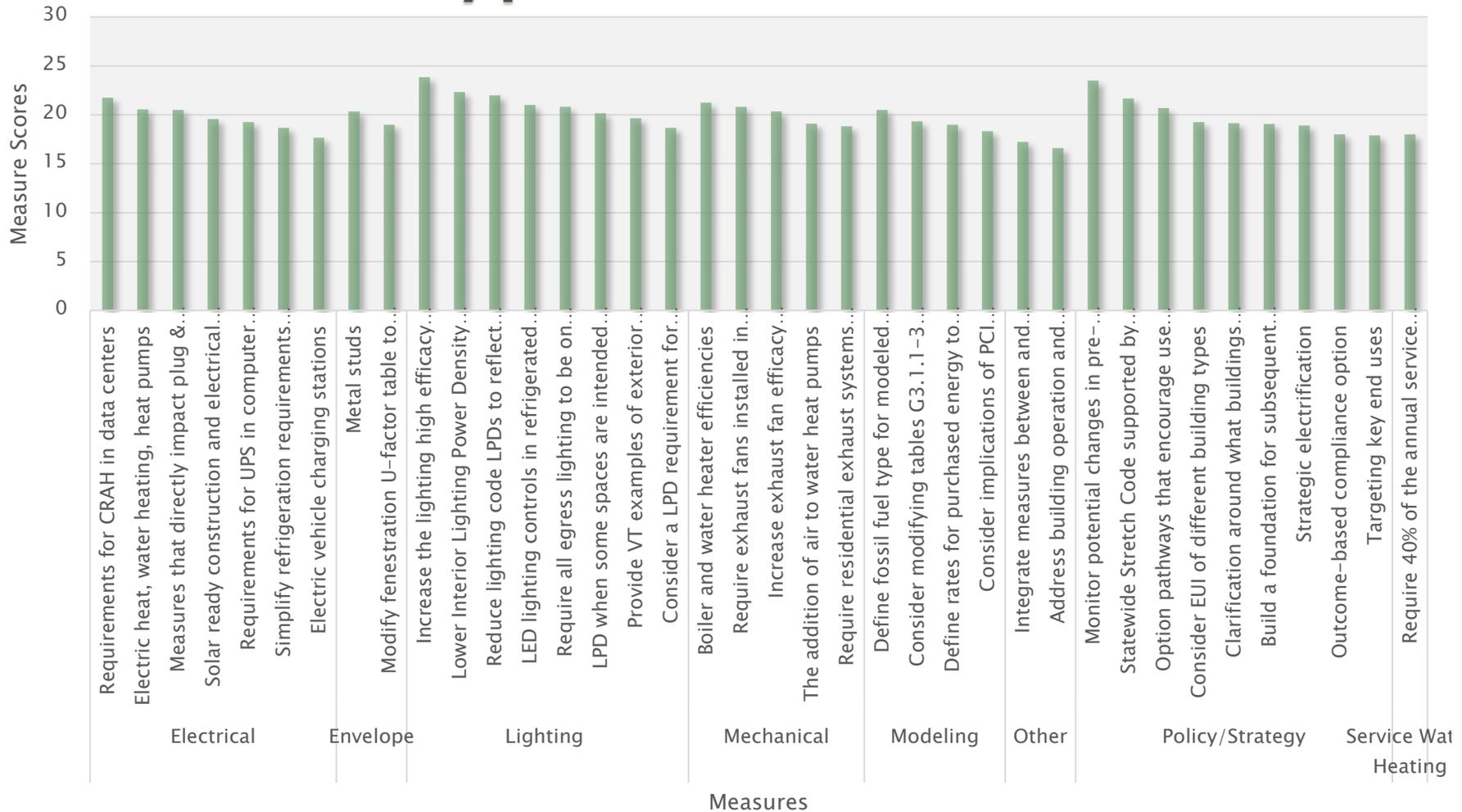
▶ Results

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

Residential Measure Scores by Measure Type



Commercial Measure Scores by Measure Type



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

»» Roadmap to
Net-Zero by
2030

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 all new buildings built to net-zero design by 2030. 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...

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.

What is a Zero Energy Building?

A Zero Energy (ZE) building* is highly energy efficient and meets $\geq 100\%$ 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 or 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.



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

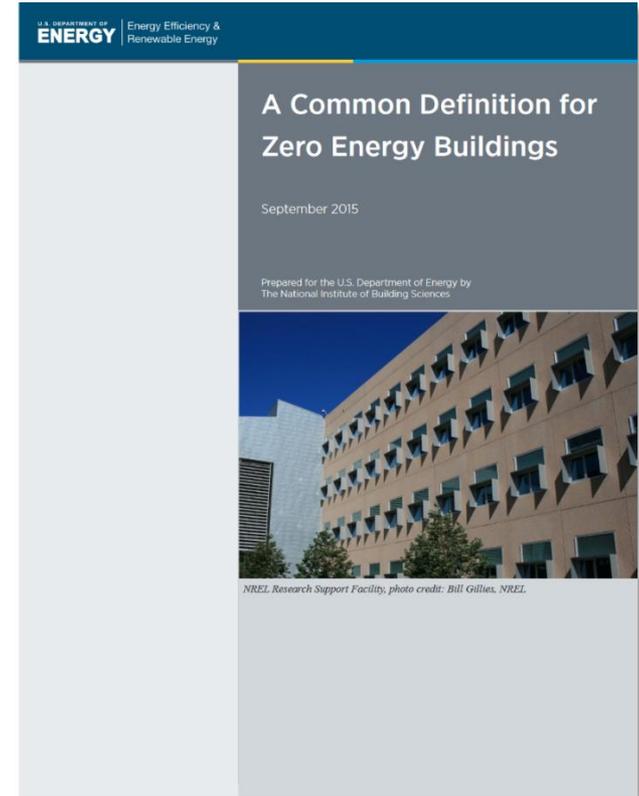
Zero Energy Definitions

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.

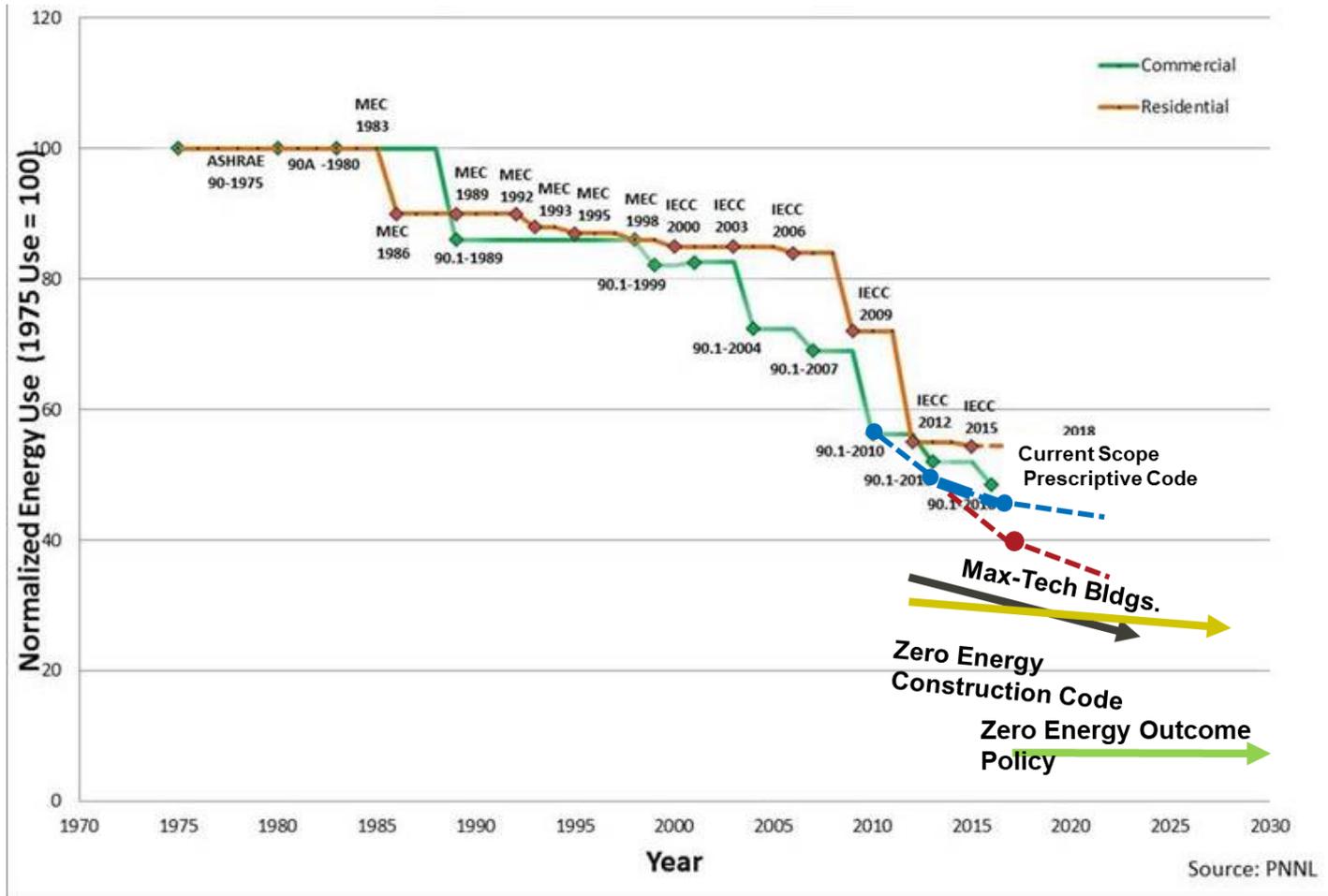
CA DGS State Administrative Manual (SAM) Section 1815.31 ZNE Definition: Energy Efficient building that produces as much clean renewable energy as it consumes over the course of a year, when accounted for at the energy generation source. Source energy represents the total amount of raw fuel that is required 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).

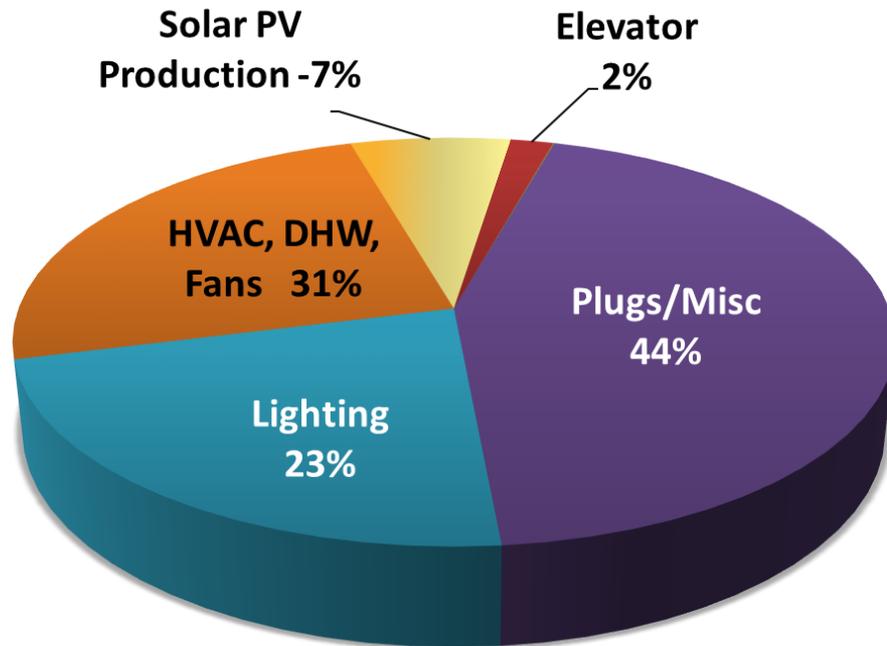


Improvement in Model Energy Codes



Opportunities for additional savings

RFM: Energy End Use based on 2 years



**NET EUI = 20
kBtu/sf/yr**

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.

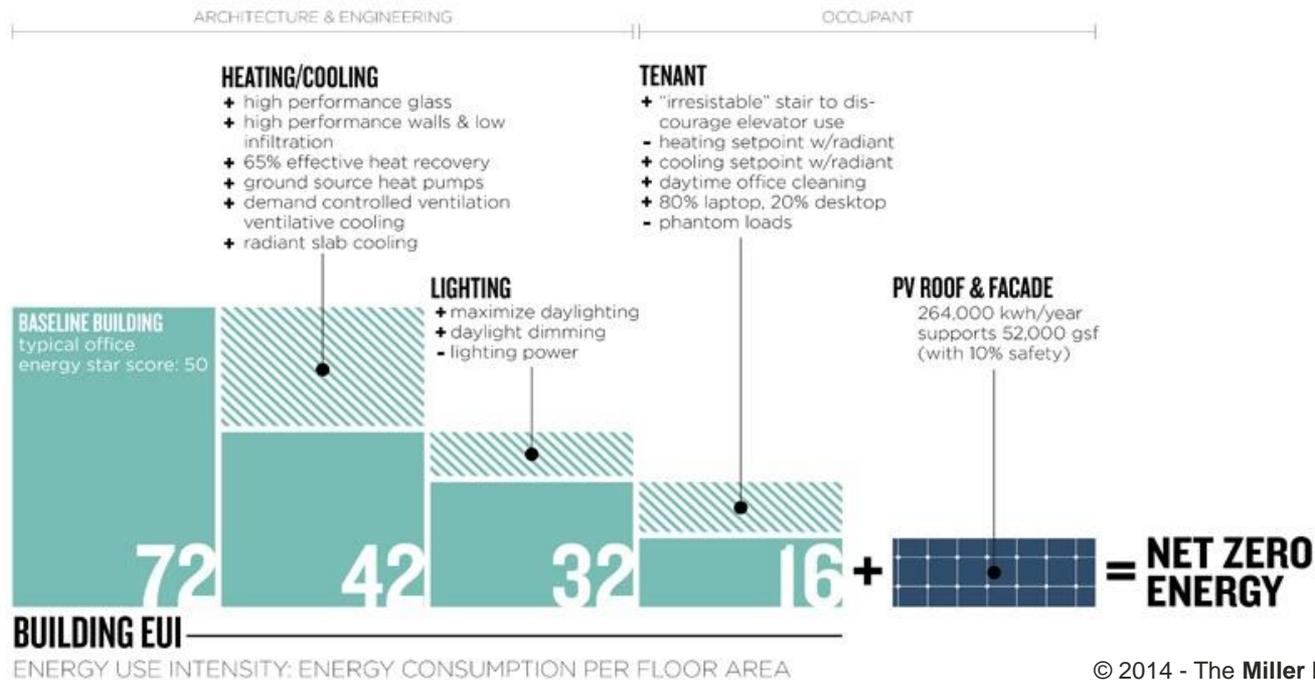
Potential Approach to Roadmap: Step 1: Establish the EUI Target

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



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

- Begin by defining your energy target and solar budget



© 2014 - The Miller Hull Partnership, LLP

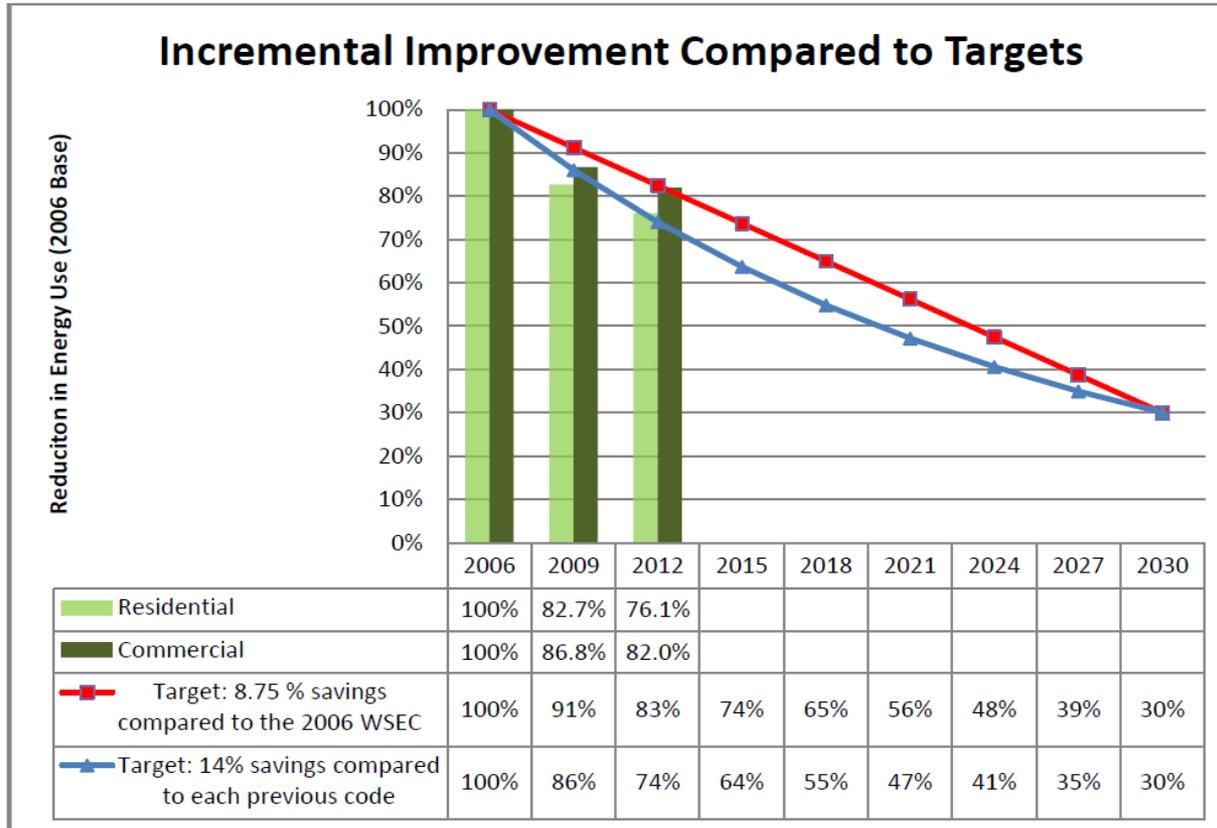
Examples of Zero Energy Targets

Table 3-1 Target EUI

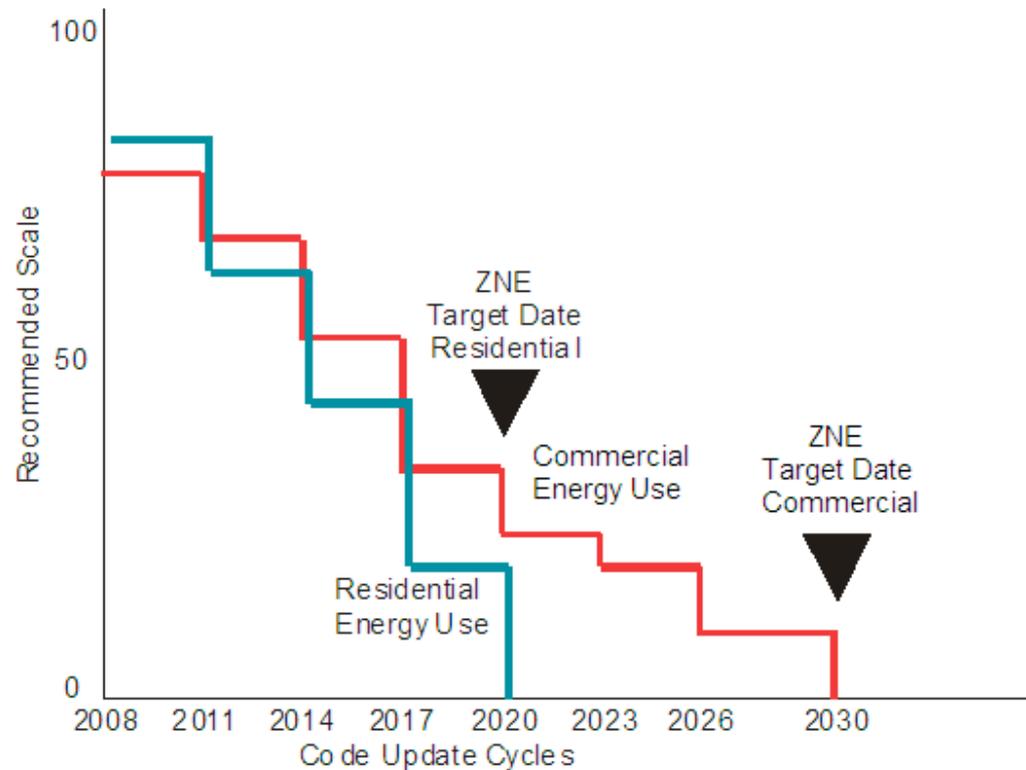
Climate Zone	Site Energy		Source Energy	
	Primary School EUI, kBtu/ft ² -yr	Secondary School EUI, kBtu/ft ² -yr	Primary School EUI, kBtu/ft ² -yr	Secondary School EUI, kBtu/ft ² -yr
0A	22.5	22.9	69.1	70.5
0B	23.1	23.2	71.4	71.6
1A	21.3	21.1	65.5	65.0
1B	21.7	21.6	66.6	66.6
2A	20.9	21.3	63.8	65.1
2B	19.6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

ASHRAE Achieving Zero Energy Design Guide for K-12 Schools

WA Code Improvement Targets



CA Title 24 – The First ZNE Roadmap



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
	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
CZ										
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

Data Sources For Potential Vermont Targets

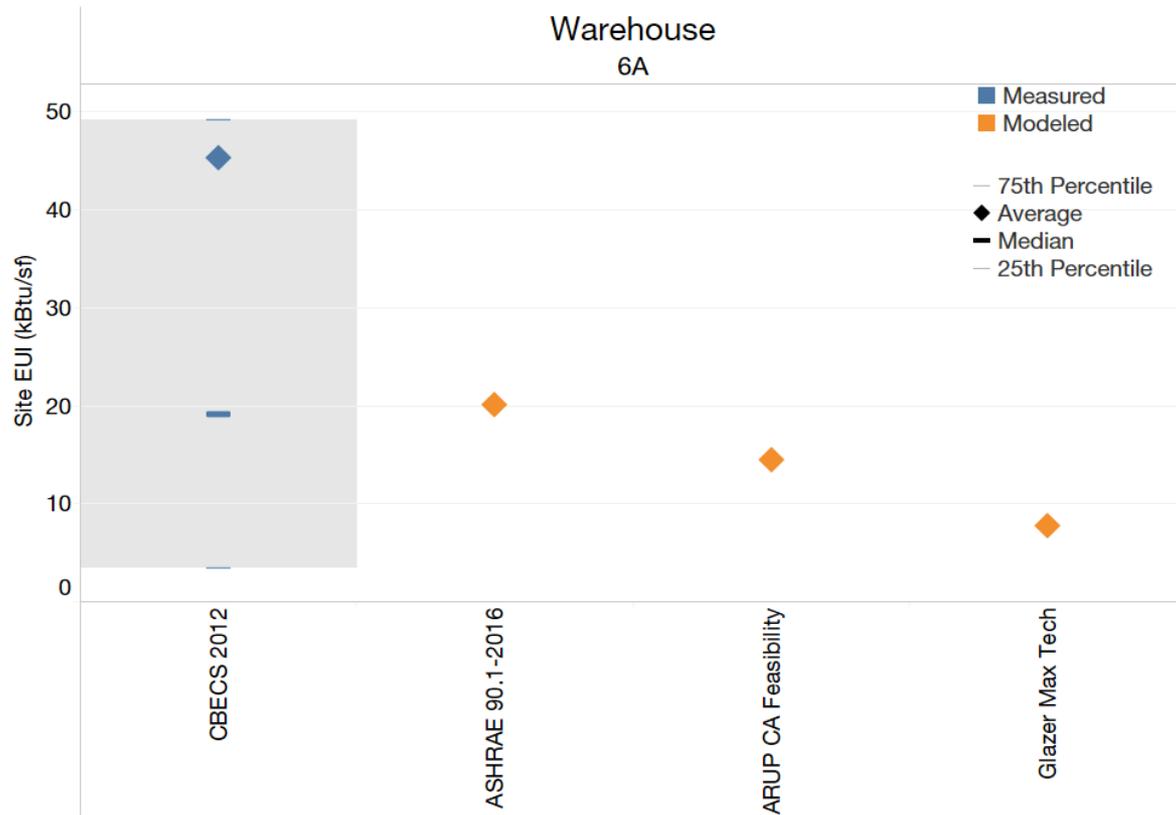
Data Sources:

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

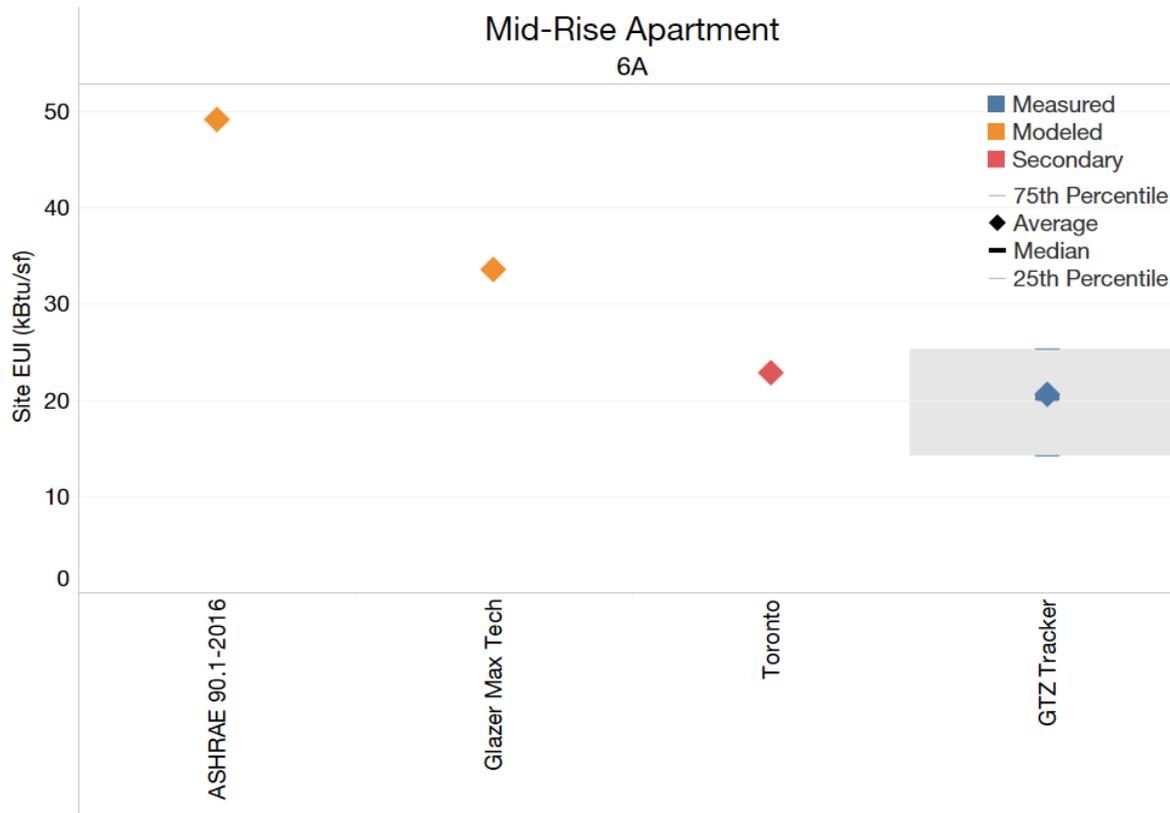
Building Type Information:

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

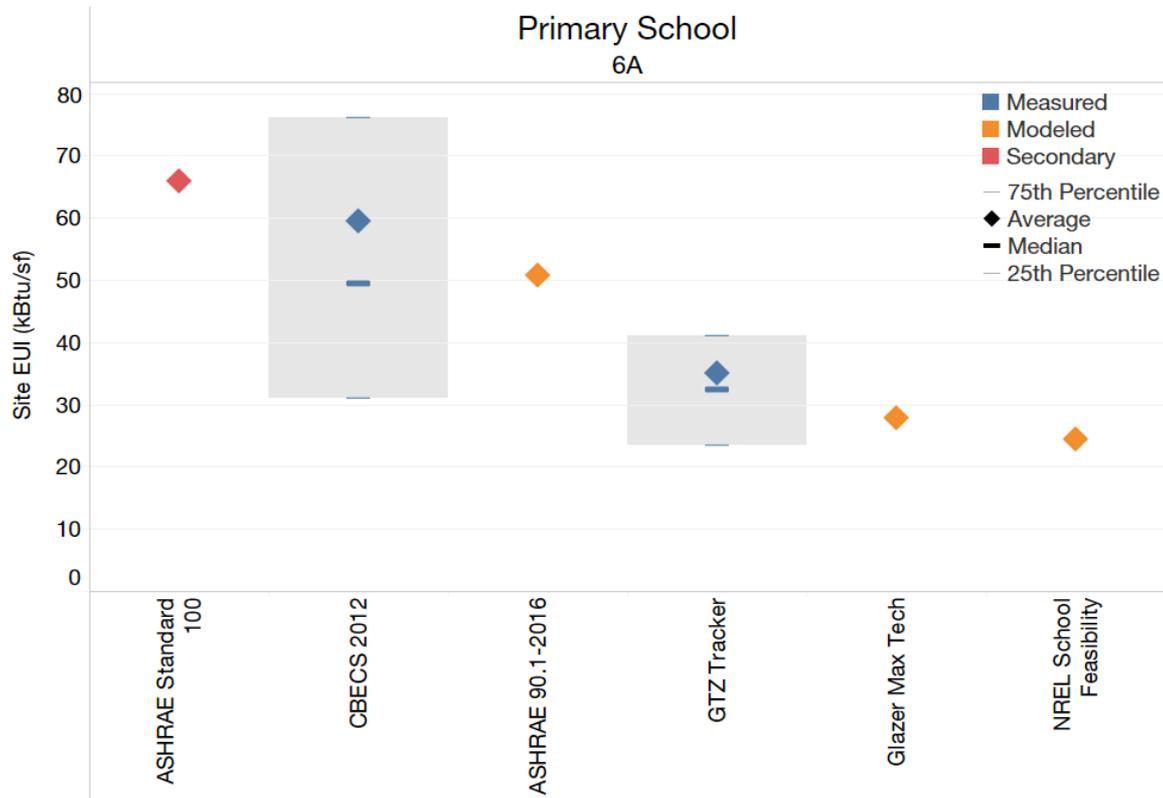
Trends in Modeled EUIs vs. Measured Data



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



Trends in Modeled EUIs vs. Measured Data Primary School



Trends in Modeled EUIs vs. Measured Data Stand Alone Retail

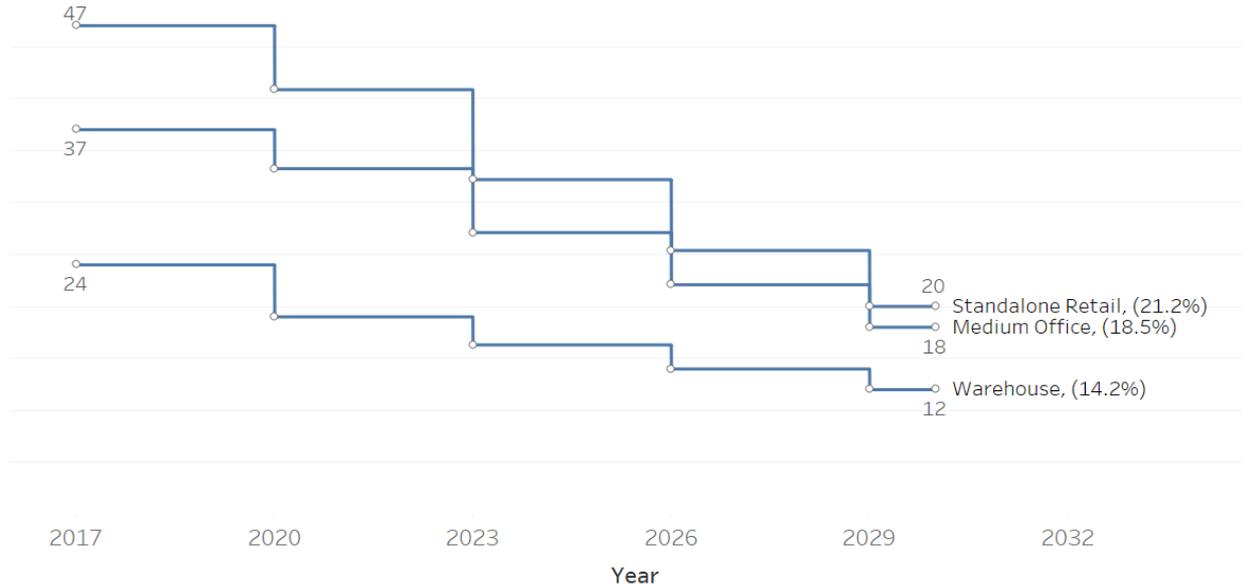


For discussion: Site EUI targets to reach a ZE code in 2029: Retail, Office, Warehouse

Site EUI (kBtu/sf) targets to reach a zero energy code in 2029

2020: 5% Better than 90.1-2016

2020-2029: Constant percent savings

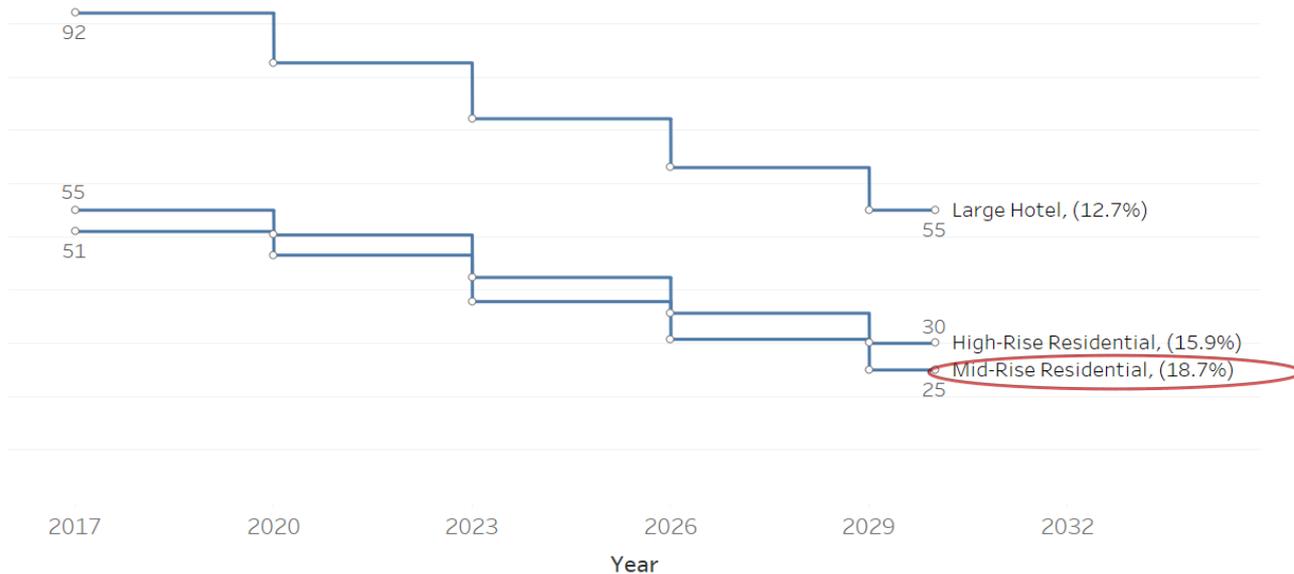


For discussion: Site EUI targets to reach a ZE code in 2029: Mid-Rise Residential

Site EUI (kBtu/sf) targets to reach a zero energy code in 2029

2020: 5% Better than 90.1-2016

2020-2029: Constant percent savings

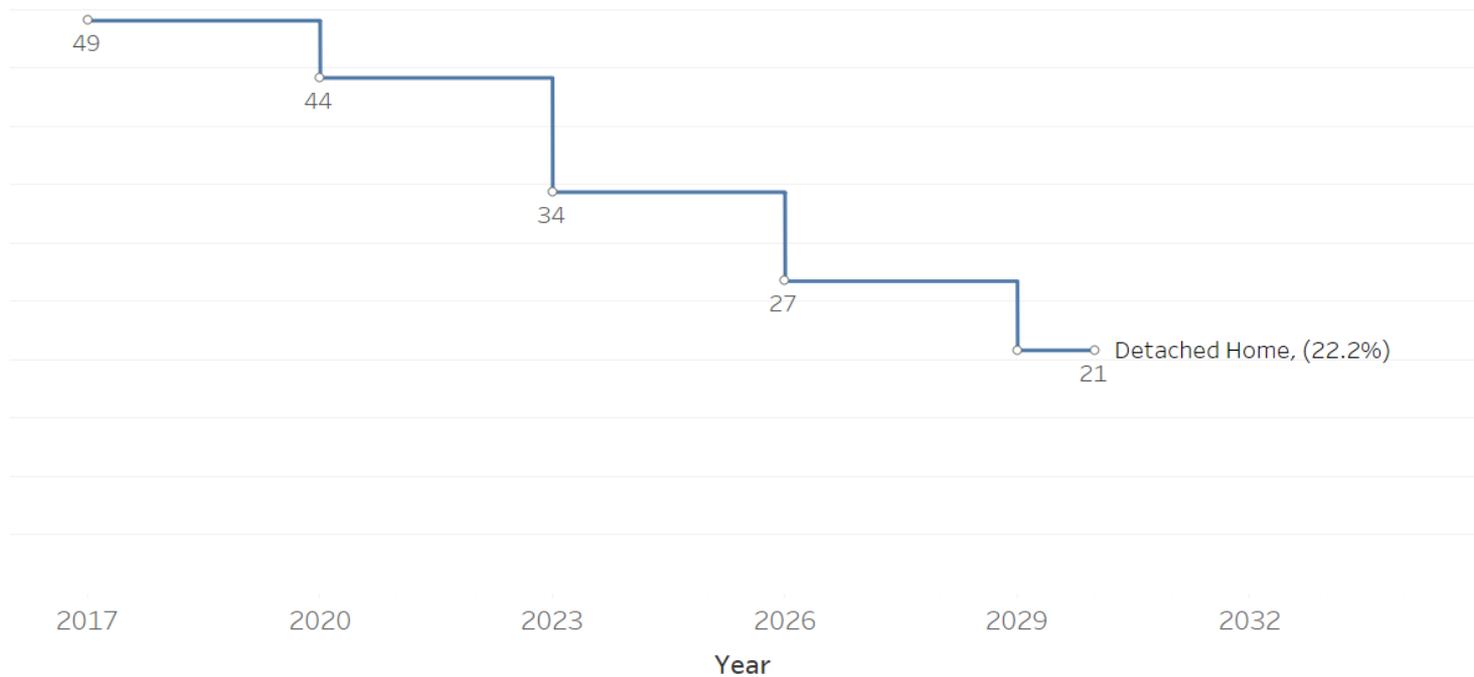


For discussion: Site EUI targets to reach a ZE code in 2029 – Detached Home

Site EUI (kBtu/sf) targets to reach a zero energy code in 2029

2020: 10% Better than 2018 IECC

2020-2029: Constant percent savings

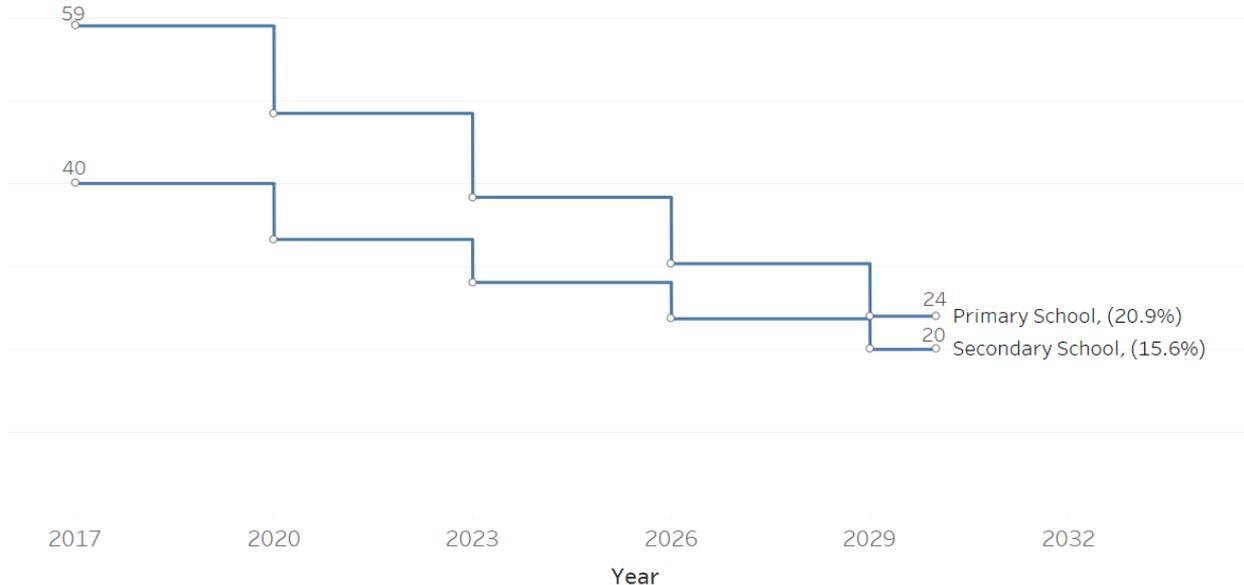


For discussion: Site EUI targets to reach a ZE code in 2029: Schools

Site EUI (kBtu/sf) targets to reach a zero energy code in 2029

2020: 5% Better than 90.1-2016

2020-2029: Constant percent savings



Potential Target Code Performance Levels

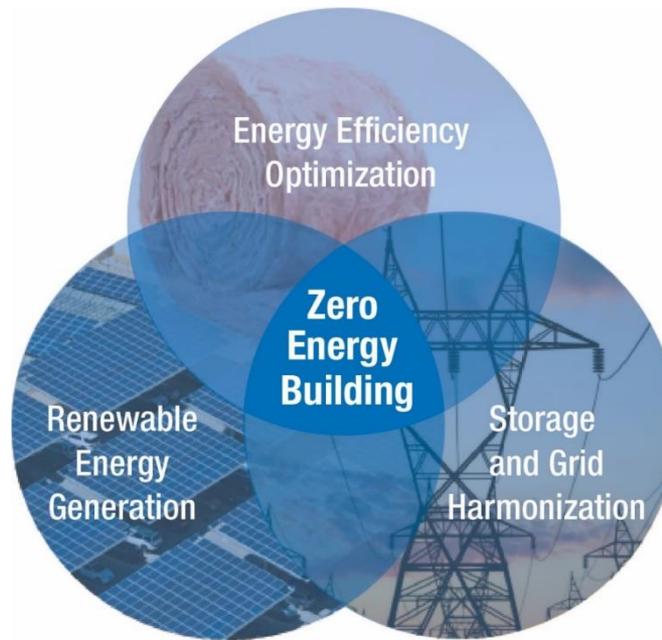
Constant Percent Savings

Year	Mid-Rise Residential	High-Rise Residential	Large Hotel	Primary School	Secondary School	Medium Office	Standalone Retail	Warehouse	Detached Home
2017	51.0	55.0	92.0	59.0	40.0	37.0	47.0	24.0	49.0
2020	46.6	50.4	82.7	48.5	33.3	33.3	40.9	19.0	44.1
2023	37.8	42.4	72.2	38.3	28.1	27.1	32.2	16.3	34.3
2026	30.8	35.7	63.0	30.3	23.7	22.1	25.4	14.0	26.7
2029	25.0	30.0	55.0	24.0	20.0	18.0	20.0	12.0	20.8
2020-2029 per cycle Savings (%)	18.7%	15.9%	12.7%	20.9%	15.6%	18.5%	21.2%	14.2%	22.2%

Code Landscape

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

Complimentary Elements in ZNE



© 2017 New Buildings Institute

» 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

Proposed Approach #1: Packages

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

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 not use Packages shown on previous slides**
- Base and Stretch met through choosing from Options menu after selecting one of two basic assembly packages

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)

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	Average u-factor ≤ 0.27 OR
	2	Average u-factor ≤ 0.22
Air Leakage and Ventilation	1	ACH50 is tested with blower door OR
	3	ACH50 ≤ 2.0 (tested) and balanced H/ERV with 75% SRE, ECM
Heating and Cooling [for all of primary system]	1	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
	3	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	ENERGY STAR, fossil fuel [EF 0.67 for ≤ 55 gal; EF 0.77 for > 55 gal] OR
	2	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	Home is PV-ready per DOE ZERH guidelines
	1	Level 2 electric vehicle charger installed in garage or primary parking area
	Up to 4	1 pt per 1.5 kW/housing unit of PV generation on site (max 4 pts)



DEPARTMENT OF PUBLIC SERVICE

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 (1 pt)
 - 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.

Proposed Approach #2: Options

STRETCH CODE

Choose one



	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

+

Pick options to get required points

	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)

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 (1 pt) + **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 $ACH50 \leq 2.0$ (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.

Other Measures to Address

Air leakage and duct testing	Clarify how measured, whether required
Ventilation alternatives	Add flexibility by considering <i>addition</i> 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

» Commercial

Proposed Compliance Approach

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

Commercial Compliance Options

1

2018 CBES – Prescriptive

OR

2

ASHRAE 90.1-2016

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

AND

- A total of six energy credits from - C406

C406.2 – Eff. HVAC Performance

C406.5 – On-site Supply of
Renewable energy

C406.7.1 and C406.7.4 – Heat Pump
Water Heating

C406.3.1 – Reduced Lighting Power
Density Option 1

C406.6 – Dedicated Outdoor Air
System

C406.8 – Enhanced Envelope
Performance

C406.3.2 – Reduced Lighting Power
Density Option 2

C406.7.1 and C406.7.2 – High-
Efficiency Service Water Heating

C406.9 – Reduced Air Infiltration

C406.4 – Enhanced Lighting Controls

C406.7.1 and C406.7.3 – High-
Efficiency Service Water Heating

C406.10 – Efficient Kitchen
Appliances

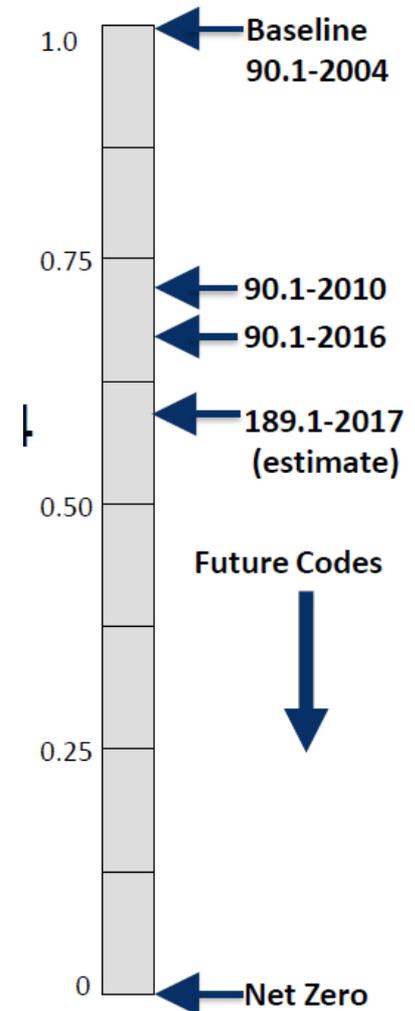


Proposed New Compliance Path

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

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

- ▶ 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

Proposed Summary of Changes

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

Source: IECC and ASHRAE summary from Pacific Northwest National Laboratory



Proposed Envelope Major Changes

- ▶ Update building envelope requirements
- ▶ Update building fenestration requirements
- ▶ Air barrier commissioning required for Materials and Assembly compliance paths
- ▶ Air leakage compliance via testing reduced to 0.40 CFM/SF
- ▶ Solar panels required on buildings with > 20,000 SF of building footprint

Proposed Lighting, Electric Power, and Other Major Changes

- ▶ Update interior lighting power density requirements
- ▶ Update exterior lighting power density requirements and remove Zone 4
- ▶ Electric vehicle charging stations required on certain buildings

Proposed Mechanical Major Changes

- ▶ Supplemental electric resistance heat is allowed on cold-climate heat pump systems with proper controls and significantly enhanced envelope
- ▶ Increased equipment efficiencies
- ▶ ERV required in all systems > 20% design outdoor air
- ▶ Economizer and fault detection required on units > 15 tons
- ▶ Required hotel/motel guestroom HVAC occupancy control

Proposed Commercial Modeling

Modeling the energy impacts of the proposed code changes 2015 vs. 2019 CBES base code-compliant buildings of three types:

- ▶ Medium Sized Office Building
 - 36,300 square feet, 3 story
 - Chiller and boiler plant
 - VAV air handling units

- ▶ Retail
 - 10,000 square feet, 1 story
 - Rooftop units

- ▶ Mid-rise Residential
 - 40,000 square feet, 4 story
 - Central cooling tower and boiler plant
 - Cold climate heat pumps per apartment

Proposed Stretch Guidelines

- ▶ 22 Proposed Stretch Guidelines for Commercial
- ▶ Major proposals
 - Building Performance Factors for modeling adjusted
 - Solar rooftop readiness required for buildings over 2,400 SF of roof area
 - Demand Control Ventilation controls
 - HVAC and refrigeration heat recovery
 - Lighting Power Density adjusted
 - Control of electrical receptacles
 - Group R-2 buildings with 20 or more dwelling or sleeping units are required to meet 2019 CBES requirements

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

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

