

# **Massachusetts Energy Code**

**DOER briefing for PHIUS**

**28 Oct 2022**

**Paul Ormond, DOER, Commonwealth of Massachusetts**

# Agenda

- Framework of Massachusetts Efficiency Code
- Stretch Code: Key requirements
- Specialized Code: Key requirements

# Base, Stretch, Specialized – 3 options

## Base Code (IECC 2021)

- New construction in towns & cities not a green community
- **52 communities**

Expected from BBRs:  
**July 2023**

## Stretch Code (2023 update)

- New construction in towns & cities that are a green or stretch community
- **299 communities**

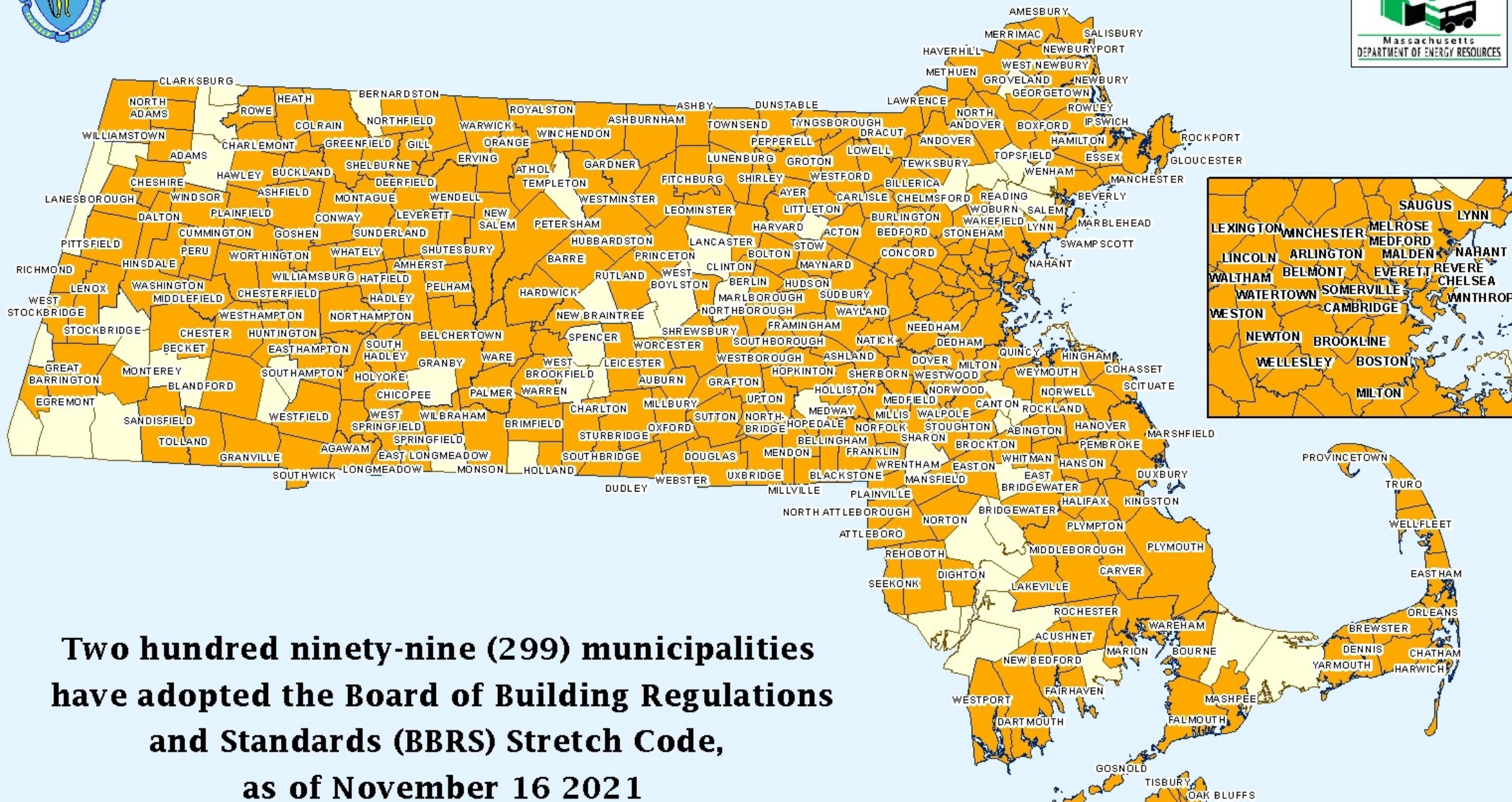
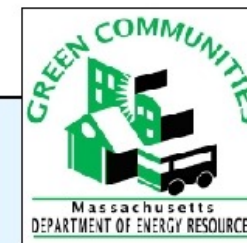
**Residential : Jan 2023**  
**Commercial: July 2023**

## Specialized Code ("Net-Zero")

- New Construction in towns & cities that vote to opt-in to this code
- **Effective date:**  
Typically 6-11 months after Town/City vote



# Stretch Code Adoption, by Community



**Two hundred ninety-nine (299) municipalities  
have adopted the Board of Building Regulations  
and Standards (BBRS) Stretch Code,  
as of November 16 2021**



# Base, Stretch, Specialized – 3 options

**Base code**

2021 IECC / ASHRAE 90.1- 2019

Modest modifications

EV ready

**Stretch code**

2021 IECC / ASHRAE 90.1- 2019

Key modifications

EV ready  
Solar ready

**Specialized code**

2021 IECC / ASHRAE 90.1- 2019

Key modifications

Passivehouse  
Multifamily

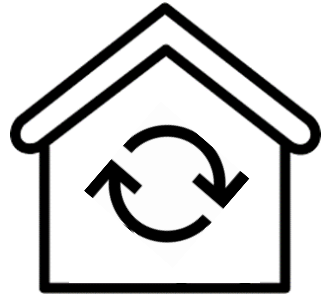
All Electric OR Net Zero OR  
electric ready + solar

EV ready  
Solar ready



## Key Modifications in Stretch Code

# Key Modifications – Stretch



**Thermal Energy  
Demand Intensity  
(TEDI) Limits**

+



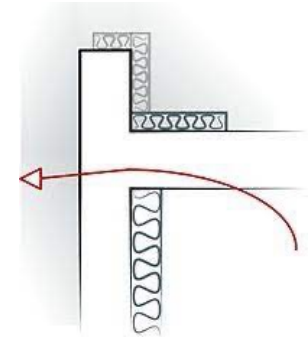
**Whole building air-  
leakage limits and  
testing**

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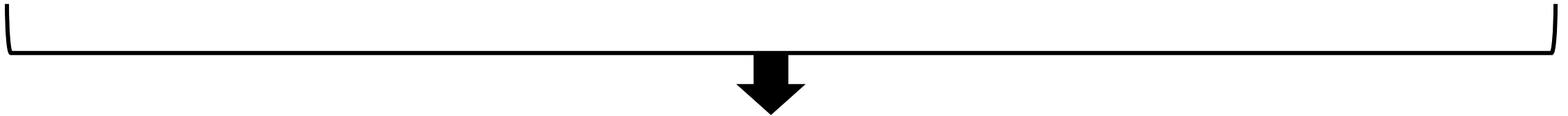


**Ventilation energy  
recovery**

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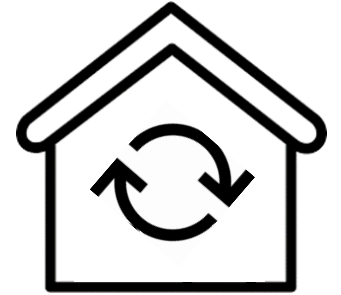


**Thermal bridge  
accounting**



Emissions, electrification, comfort, durability, and resilience benefits

# Thermal Energy Demand Intensity (TEDI)



## Heating TEDI

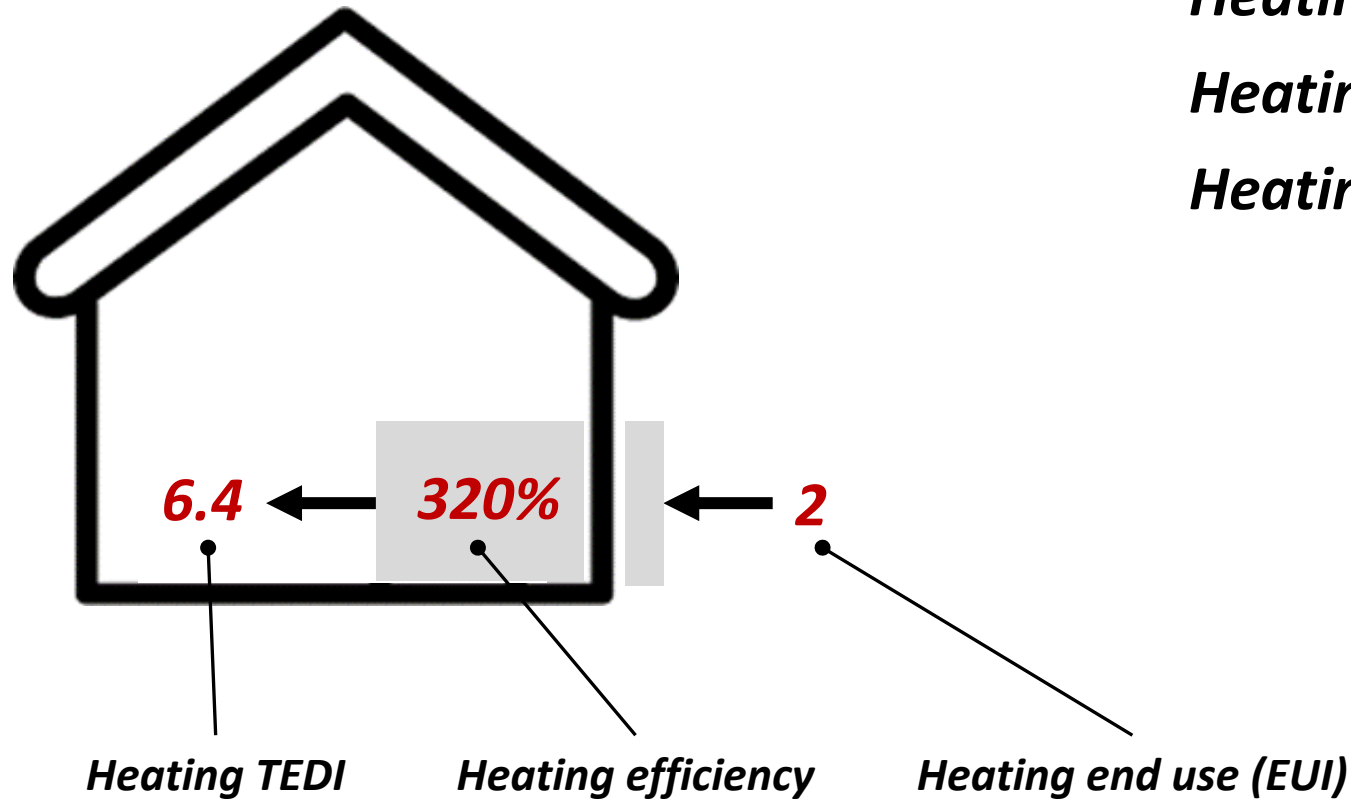
*Total annual energy **delivered to** the building for space conditioning and conditioning of ventilation air, normalized by area (kBtu/sf-yr)*

## Cooling TEDI

*Total annual energy **removed from** the building for space conditioning and conditioning of ventilation air, normalized by area (kBtu/sf-yr)*



# Connection between TEDI and EUI



*Heating end use EUI: 2 kBtu/sf-yr*

*Heating efficiency: 320%*

*Heating efficiency: 6.4 kBtu/sf-yr*

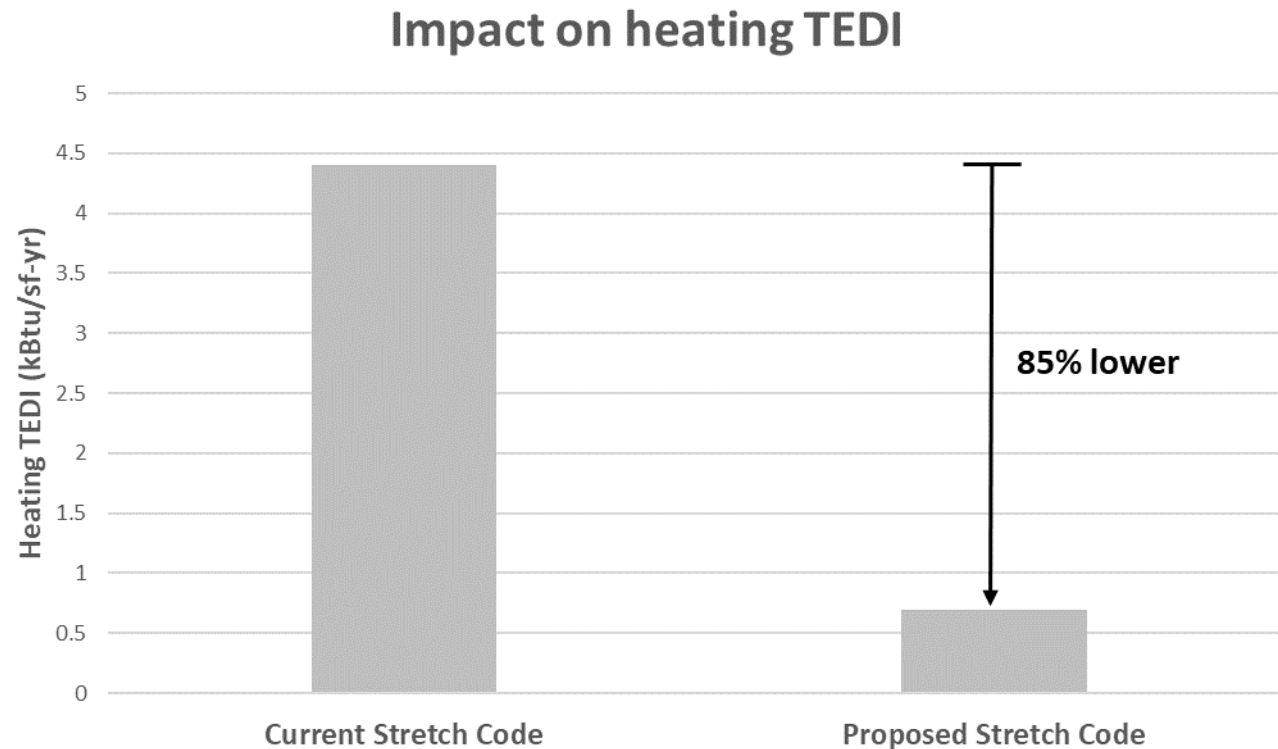
TEDI is not the same as EUI. TEDI is a measure of envelope performance, air infiltration, and ventilation energy recovery.

EUI is a measure of the above, plus equipment efficiency.

TEDI is demand while EUI is consumption

Regulating TEDI means prioritizing envelope, air infiltration, and energy recovery

# Benefits of TEDI limits



- 85% less heating demand
- Emissions reduced
- Electrification easier
- Comfort
- Durability
- Resilience

# TEDI limits example – K-12 school



Size of School building	Heating TEDI limit (kBtu/sf-yr)	Cooling TEDI limit (kBtu/sf-yr)
K-12 school ( $\geq 125,000$ -sf)	2.2	12
K-12 school (75,000 to 125,000)	$2.7 - 0.000004 * \text{Area (sf)}$	$32 - 0.00016 * \text{Area (sf)}$
K-12 school ( $<75,000$ )	2.4	20

*The same models currently used for stretch code compliance also produce TEDI information*



*Strange equations simply draws straight line between values*

# Managing cooling TEDI



## Managing cooling TEDI

- Low solar heat gain coefficient (SHGC) windows
- Recessed windows
- External shading
- Reduced air leakage rate



# Whole building infiltration



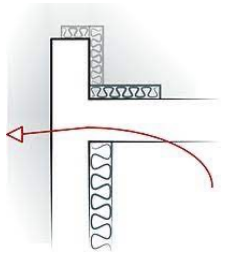
Above photo: RDH/Advanced Building Analysis

- Limit of 0.35 cfm/sf at 75 Pa
- Mandatory field testing
- Credit for even lower air infiltration
- Passive House: routinely gets 0.08 cfm/sf at 75 Pa

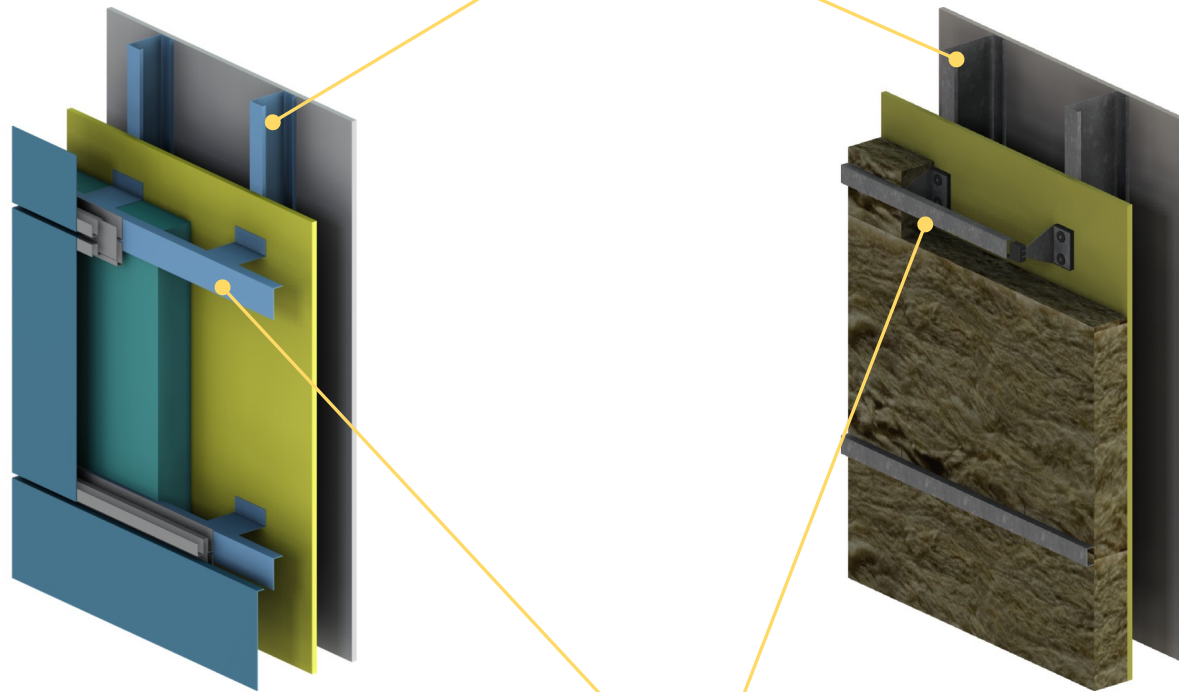
Above photo: Steven Winter Associates



# Thermal bridge accounting



*Wall studs: recognized by current code*

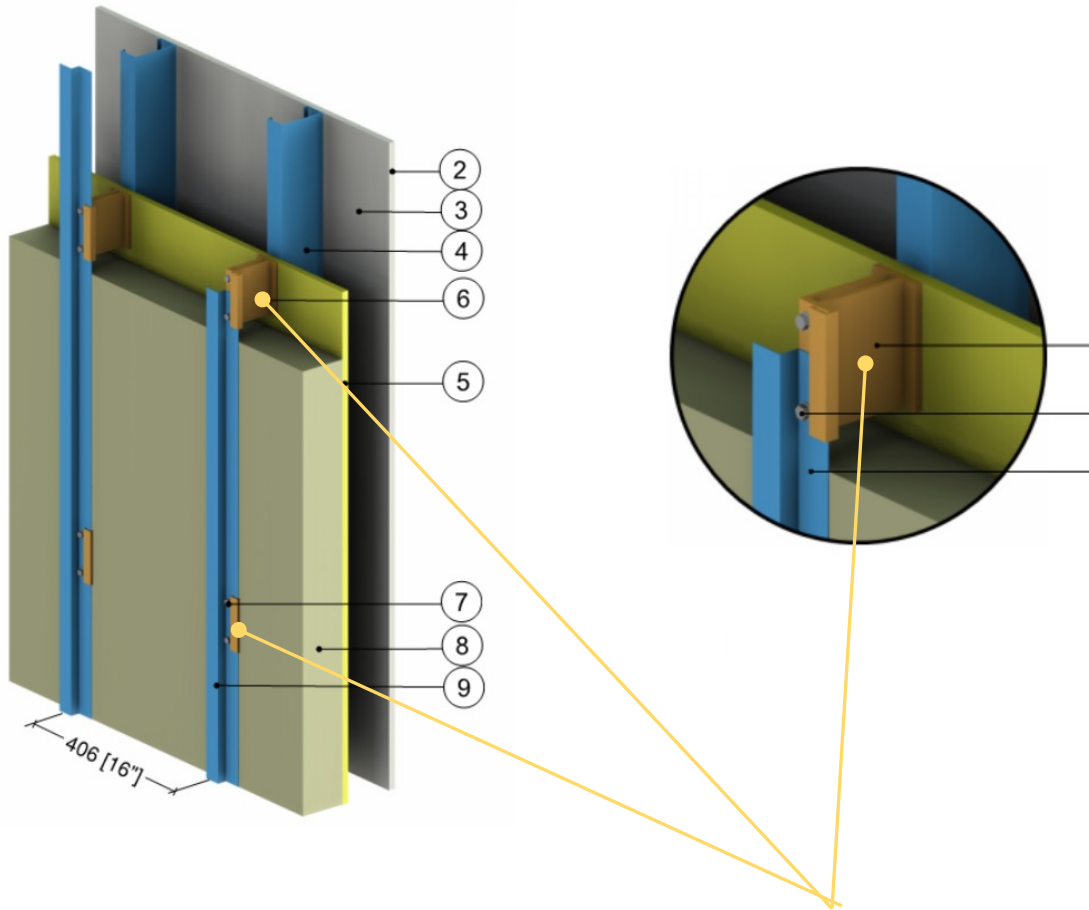
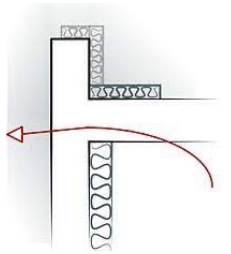


*Fasteners: Not recognized by current code*

- “Continuous insulation” is NOT continuous. There are fasteners, often metal, which go through the insulation.
- Current stretch code only recognizes thermal bridges caused by wall studs. Current stretch code does not recognize thermal bridges caused by fasteners
- Fasteners have major impact on insulation performance



# Thermal bridge accounting

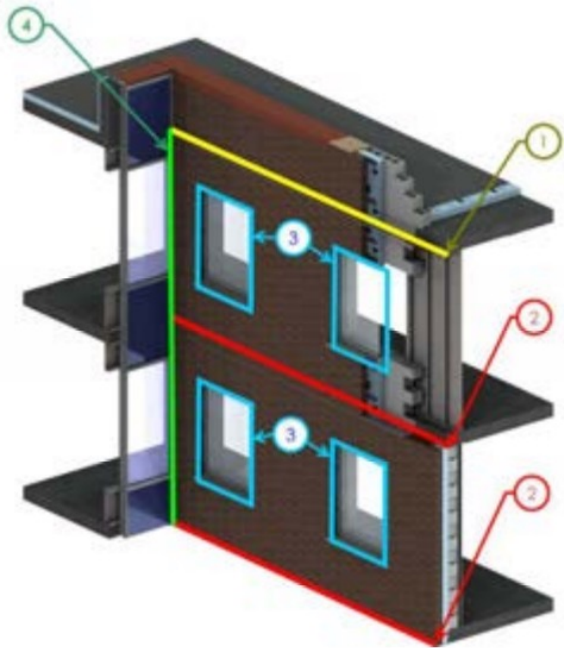
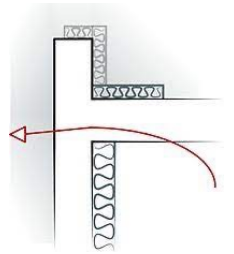


***Fasteners made from fiberglass  
provide thermal break***

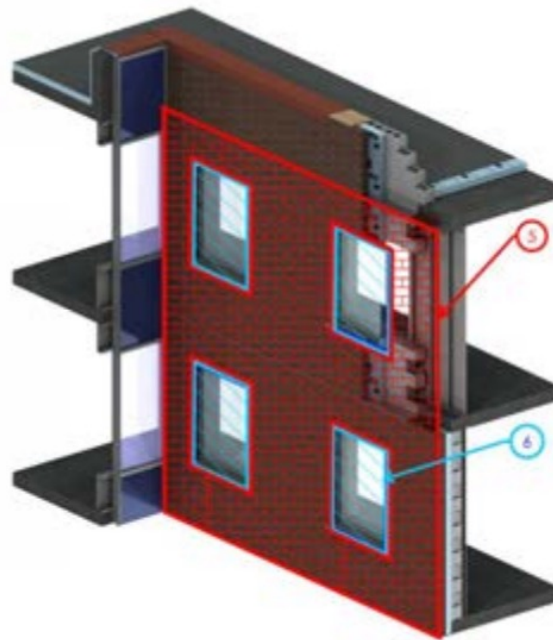
- Solution is to include fasteners that have thermal breaks
- Thermal breaks are often value engineered out because code does not mandate thermal bridge accounting
- Proposed stretch code will mandate thermal bridge accounting which will help protect designs and ensure thermally broken fasteners are used.



# Thermal bridge accounting



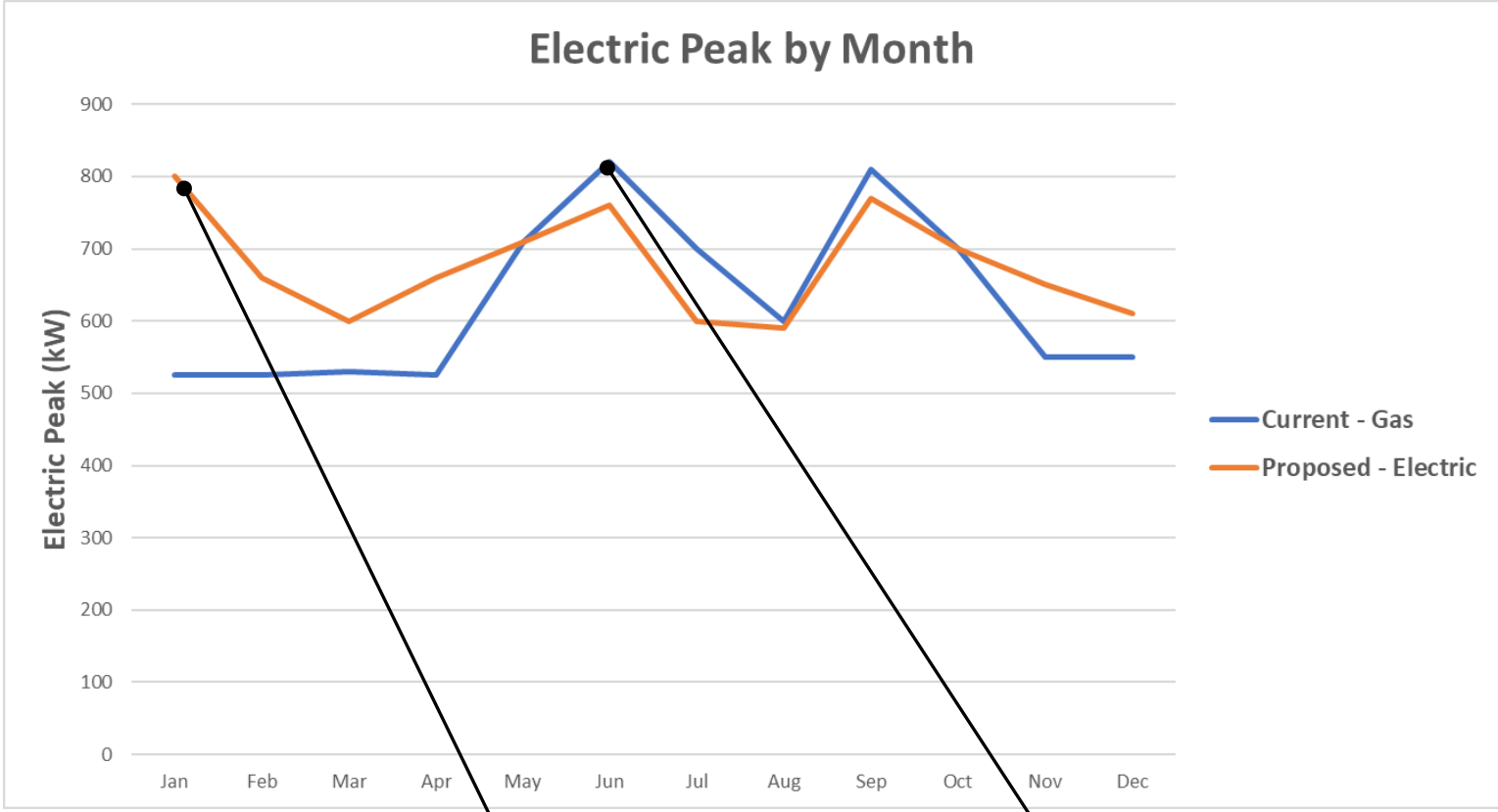
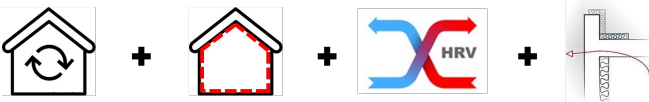
1. Parapet Length
2. Slab Lengths
3. Wall to Window Transition Lengths



4. Corner Length
5. Opaque Brick Wall Area
6. Glazing Area

- Many other thermal bridge locations not recognized by current stretch code
  - Continuous insulation
  - Brick shelves
  - Balconies/protrusions
  - Window/wall intersections
  - Parapets
  - Wall/wall intersections
  - Wall/floor intersections
- Updated stretch code does recognize these. Thermal breaks are available for all these locations

# Electrification benefits

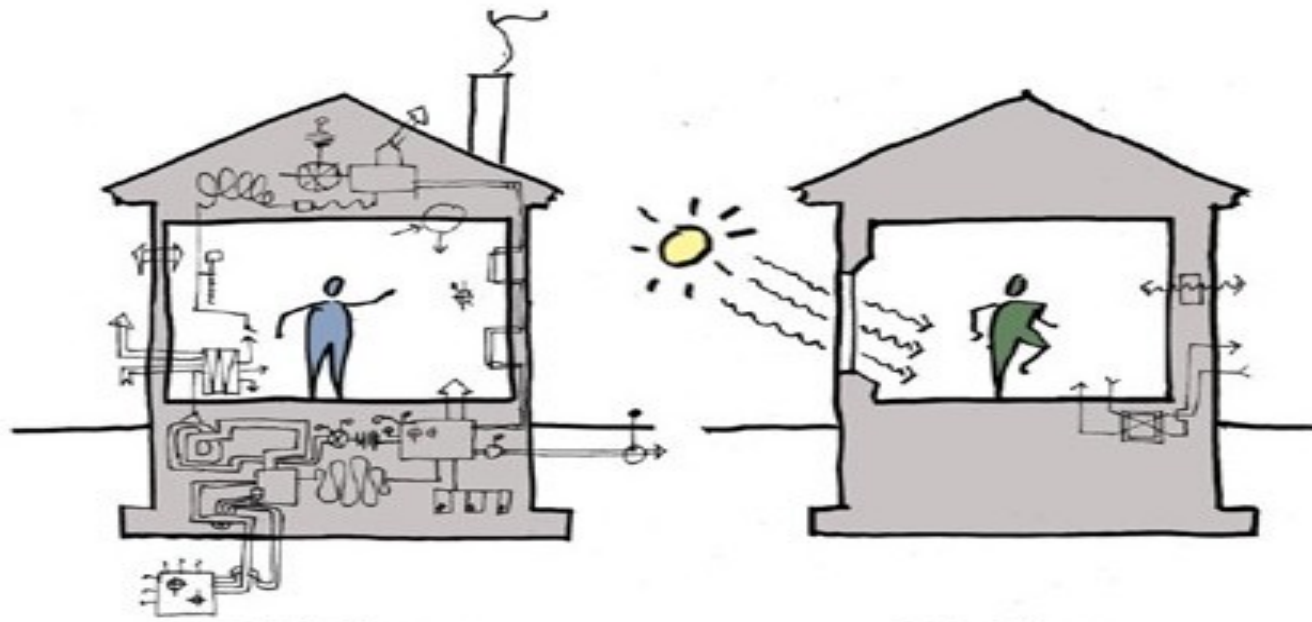
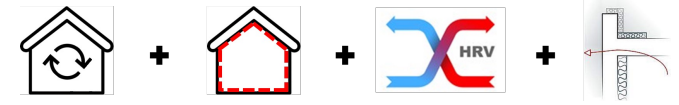


*Peak electric use ELEC heated building built to proposed stretch code*

*Peak electric use GAS heated building built to current stretch code*

The proposed stretch code allows transition to electric heating (from gas) without increasing peak electric.

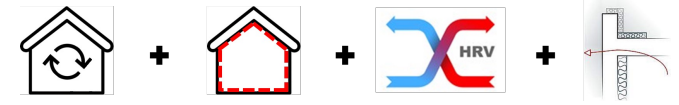
# Durability benefits



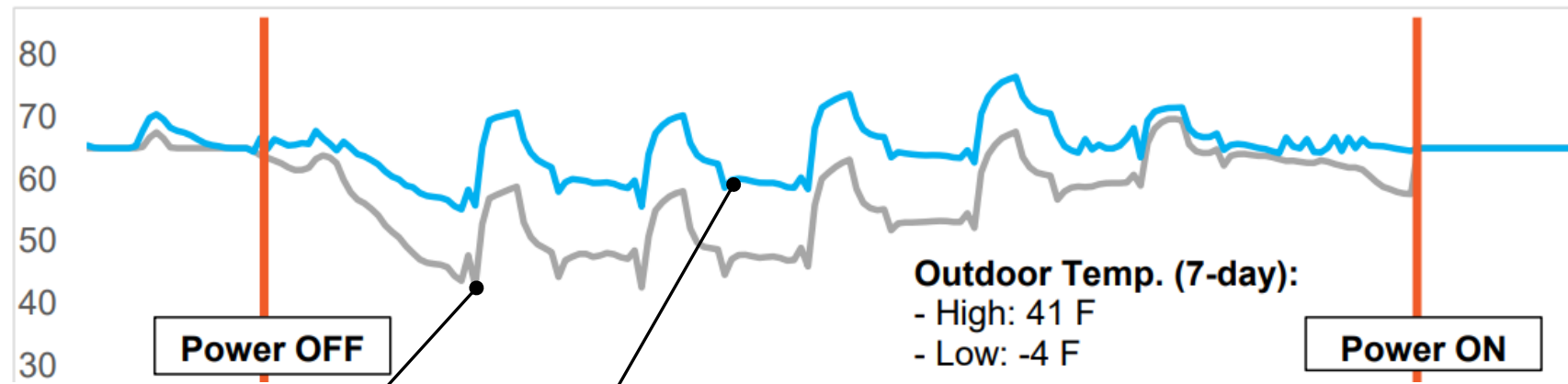
A focus on heating/cooling TEDI results in:

- Smaller HVAC systems
- More robust envelope
- Less moving parts

# Resilience/comfort benefits



Indoor Temperature During Winter Power Outage (°F, 7 days in January)



*Current  
Stretch Code*

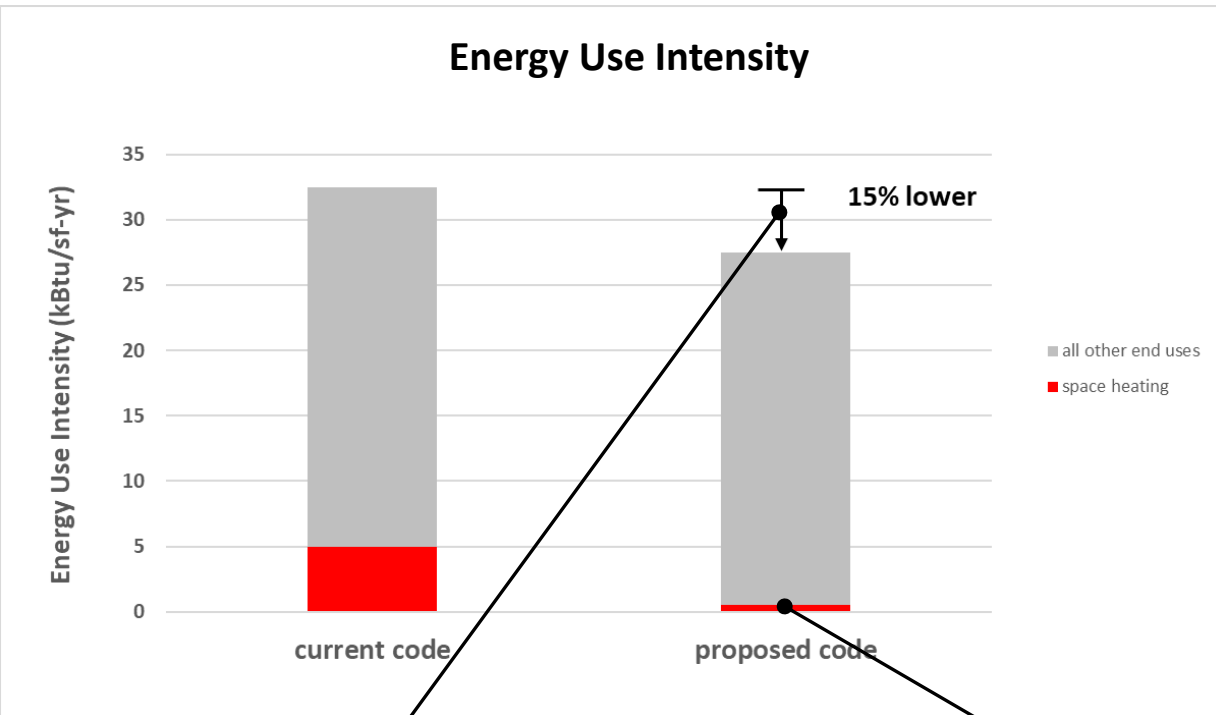
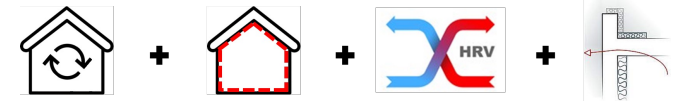
*Proposed  
Stretch Code*

If power is lost, current stretch code building quickly goes to almost 40 F interior

Proposed stretch code – always stays above 55 F interior.



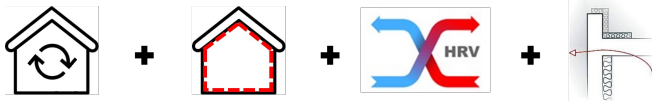
# Emissions benefits Massachusetts emission rates



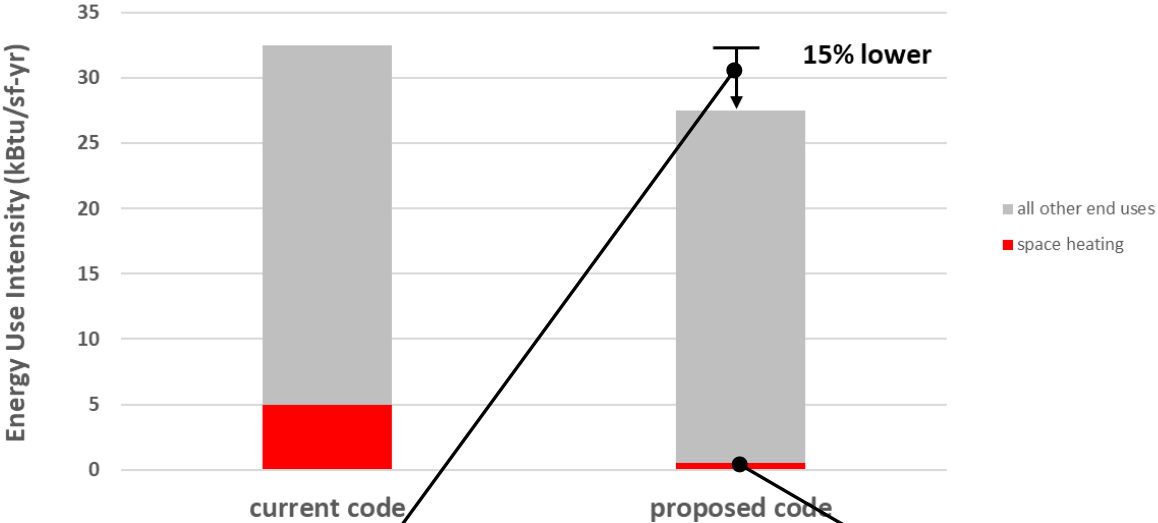
***Overall reduction in energy use seems modest (15%)***

***However, heating end use is significantly reduced (90%)***

# Emissions benefits Massachusetts emission rates



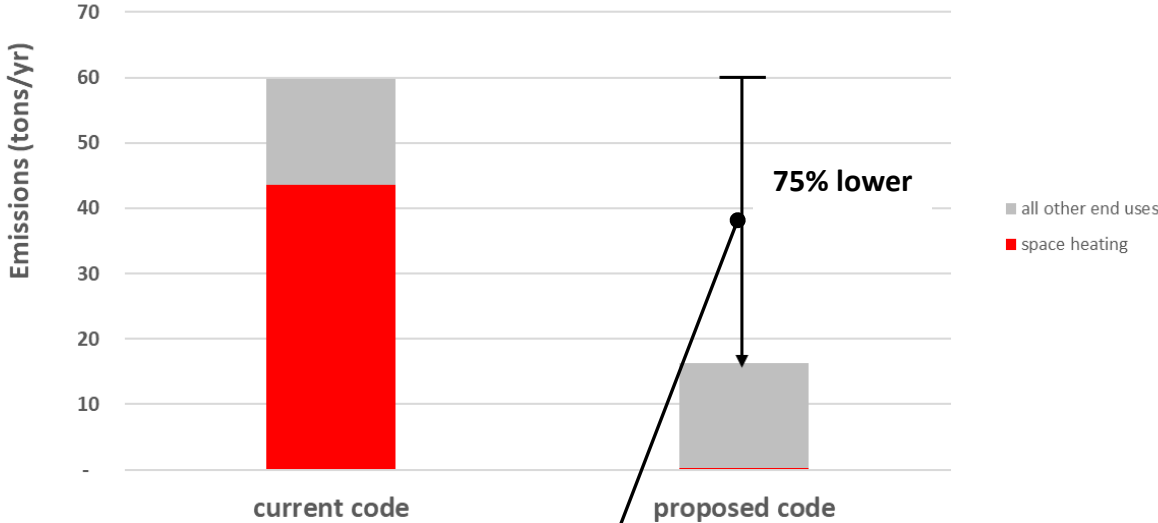
### Energy Use Intensity



**Overall reduction in energy use seems modest (15%)**

**However, heating end use is significantly reduced (90%)**

### Emissions in 2050



**The payoff is huge reduction in building emissions (75%)**

# Other Key Modifications: Envelope Backstop

*Current IECC and ASHRAE allow unlimited envelope performance tradeoff.*

*Stretch code will mandate minimum vertical area-weighted U value performance.*



# Other Key Modifications: Electrification

***Current IECC and ASHRAE has no requirements for electrification.***

***Stretch code will mandate hybrid electrification for highly-ventilated buildings and full electrification for highly-glazed buildings.***

***Specialized will mandate additional electrification provisions (more below)***





# Other Key Modifications: Tenant spaces

***Tenant spaces often treated as renovation in code.***

***Stretch code will mandate that tenant spaces, when built for first time, are treated like new construction.***





# Other Key Modifications: Mixed use buildings

*Mixed use buildings are not well addressed/over simplified in IECC/ASHRAE*

*Stretch code will mandate that each different use space separately and independently conform to respective code mandates.*



# Other Key Modifications: Residential

***IECC 2018 & 2021 has ERI (HERS rating) optional path, that is rarely used.***

***MA stretch code requires a 3rd party certified energy rating – Today at HERS 55 or Phius 2018 levels.***

***After Jan 1, 2023 – large additions and alterations also require HERS ratings***



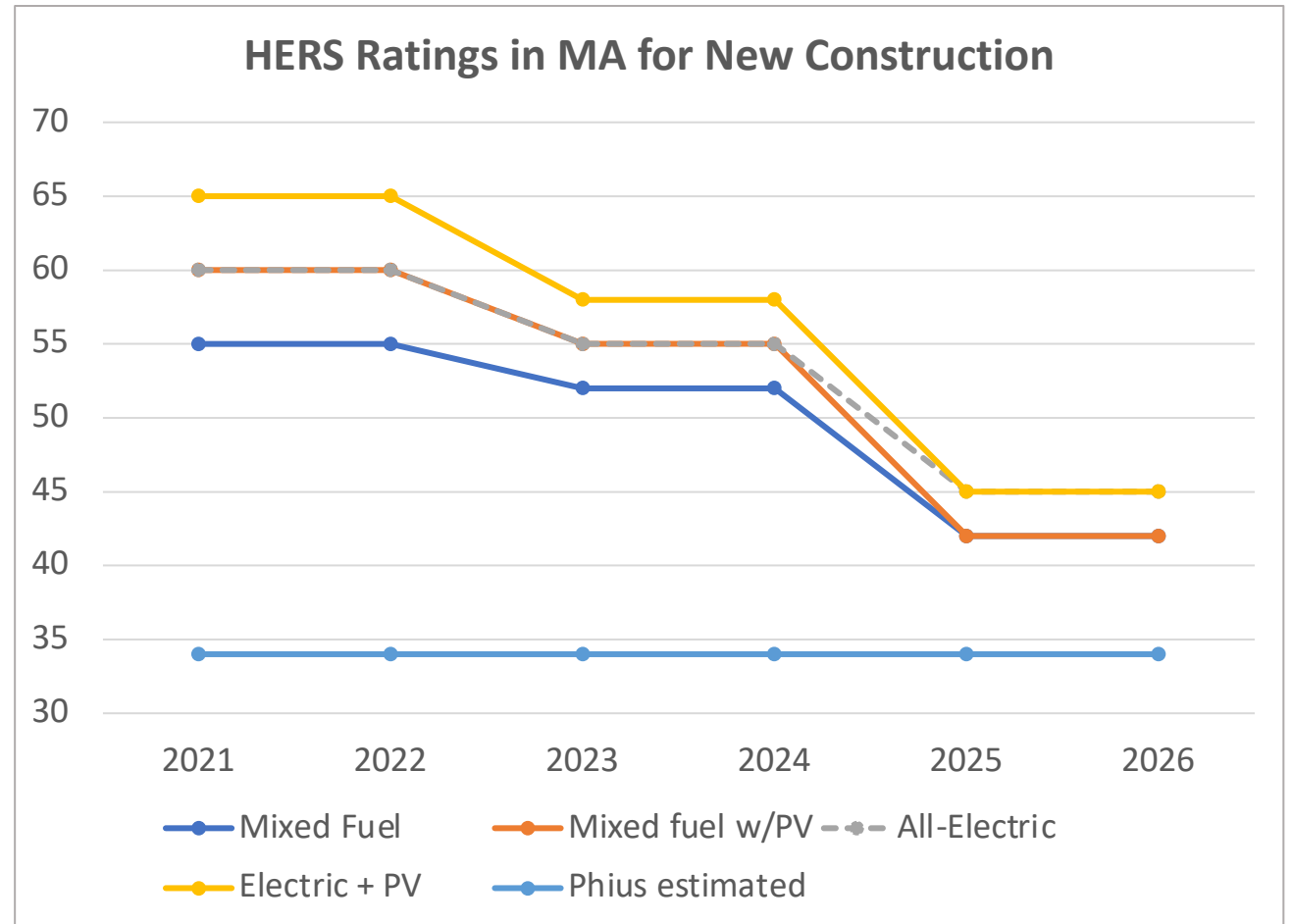
# Residential low-rise: New Construction

## Stretch Code

- HERS or Phius/PHI required
- Moving towards Phius levels
  - HERS 42 for fossil-fuel use
  - HERS 45 for all-electric
- EV ready min. 1 parking space

## Specialized Code

- Solar required for fossil-fuel use & pre-wiring for electrification
- Net-zero for new homes >4,000 sf



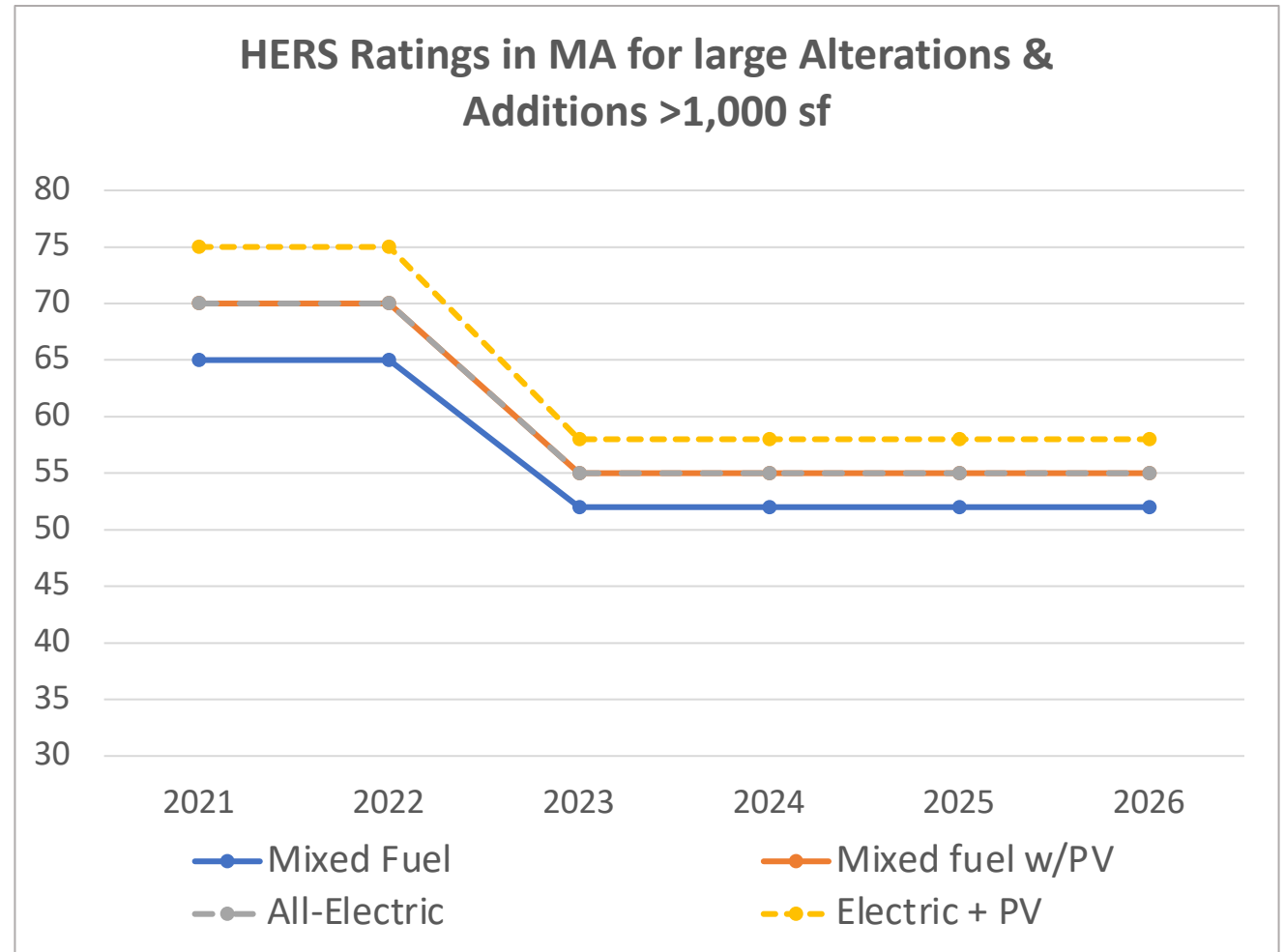
# Residential low-rise: Large additions and alterations >1,000 sf

## Stretch Code

- HERS or Phius/PHI required
- HERS 52 for fossil-fuel use
- HERS 55 for all-electric or solar
- HERS 58 for all-electric + Solar

## Specialized Code

- Same as stretch code







# SPECIALIZED CODE



# Base, Stretch, Specialized – 3 options

**Base code**

2021 IECC / ASHRAE 90.1- 2019

Modest modifications

EV ready

**Stretch code**

2021 IECC / ASHRAE 90.1- 2019

Key modifications

EV ready  
Solar ready

**Specialized code**

2021 IECC / ASHRAE 90.1- 2019

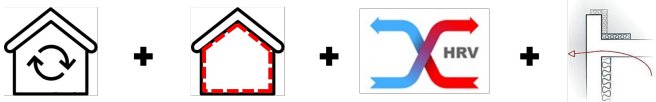
Key modifications

Passivehouse  
Multifamily

All Electric OR Net Zero OR  
electric ready + solar

EV ready  
Solar ready

# Specialized Code



- TEDI limits
- Air infiltration
- Ventilation energy recovery
- Thermal bridging
- Others
- Passivehouse Multifamily
- Low HERS

Meet all the requirements of stretch code



All electric systems

or

Rooftop solar where feasible and electric readiness

or

Net Zero energy on-site with all electric systems  
Or electric readiness if using gas

# Solar PV minimum sizing

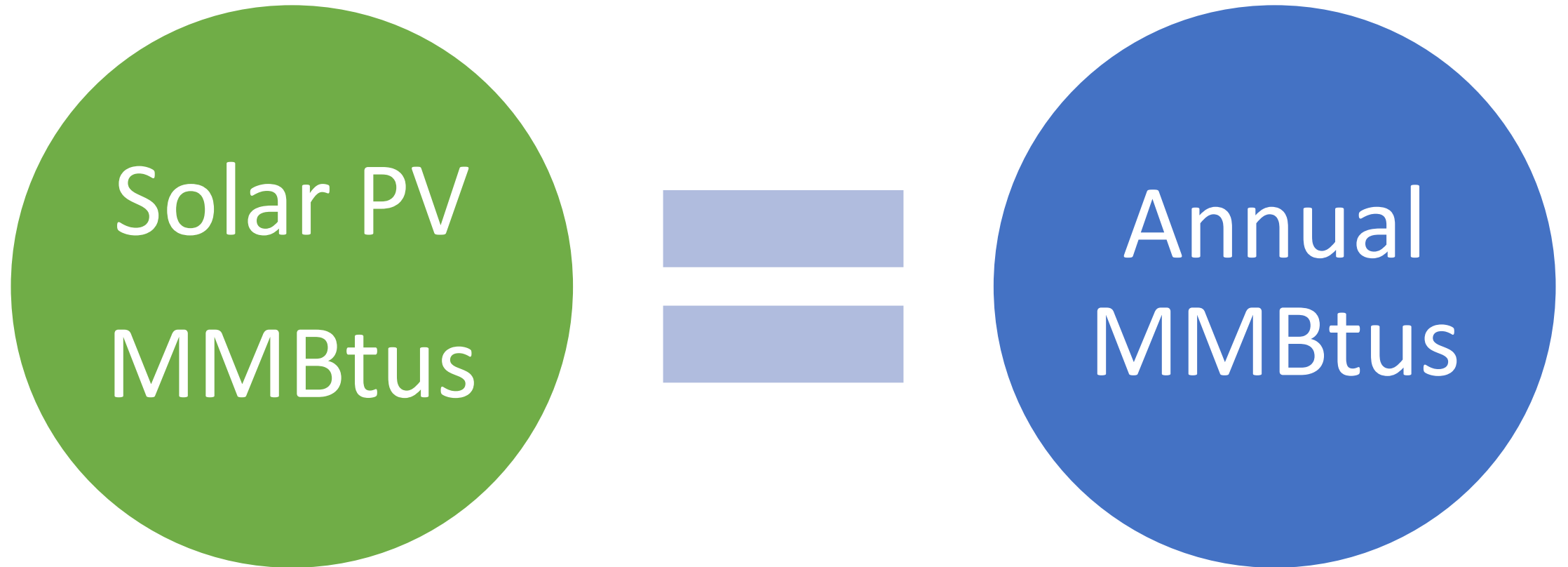
**CC105.2 On-site renewable energy.** New mixed-fuel buildings shall have equipment installed for on-site renewable energy with a rated capacity of not less than 1.5 W/ft<sup>2</sup> (16.1 W/m<sup>2</sup>) multiplied by the sum of the gross conditioned floor area of the three largest floors.

**Exception:** Where the building site cannot meet the requirement in full with an on-site renewable energy system, the building site shall install a partial system designed to utilize not less than 75% of the *Potential Solar Zone Area*.

Examples of minimum Solar PV size:

- 4 story 200,000 sf High school: 160,000 sf on 3 largest floors  
Min. Solar = 1.5 x 160,000 = 240 kW system
- 3 story 80,000 sf Elementary  
Min. Solar = 1.5 x 80,000 = 120 kW system

# Net Zero with On-site renewables



# Specialized code: Passivehouse for Multi-family

***Passive house (Phius or PHI) mandatory for all R-use (multifamily) buildings over 12,000-sf beginning 1 January 2024***

**TABLE CC101.2 MULTI-FAMILY AND R-USE COMPLIANCE**

R-Use buildings over 12,000 sf, or R-Use portions over 12,000 sf in mixed-use buildings	Compliance Path options by permit submittal date		
	C407.3 Passive house	C407.1 Targeted Performance	C407.4 HERS Index
Up to 5 stories	Required from Jan 1, 2023		
6 stories and higher	Required from Jan 1, 2024	Optional until Jan 1, 2024	Optional until Jan 1, 2024





# Study Teams

Commercial and large multifamily



**CONSIGLI**  
*Est. 1905*

**BURO HAPPOLD**

Residential low rise



**NORESCO**

# Questions?

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Contact DOER:

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Paul Ormond

<https://www.mass.gov/info-details/stretch-energy-code-development-2022>