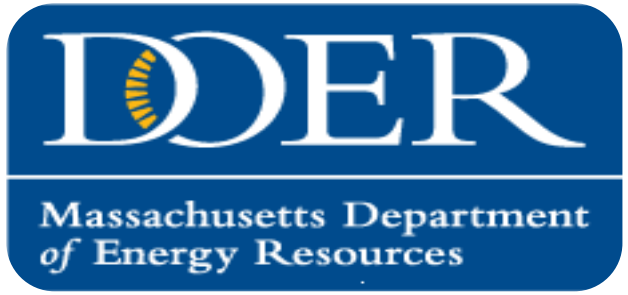
Creating A Clean, Affordable, Equitable and Resilient Energy Future For the Commonwealth



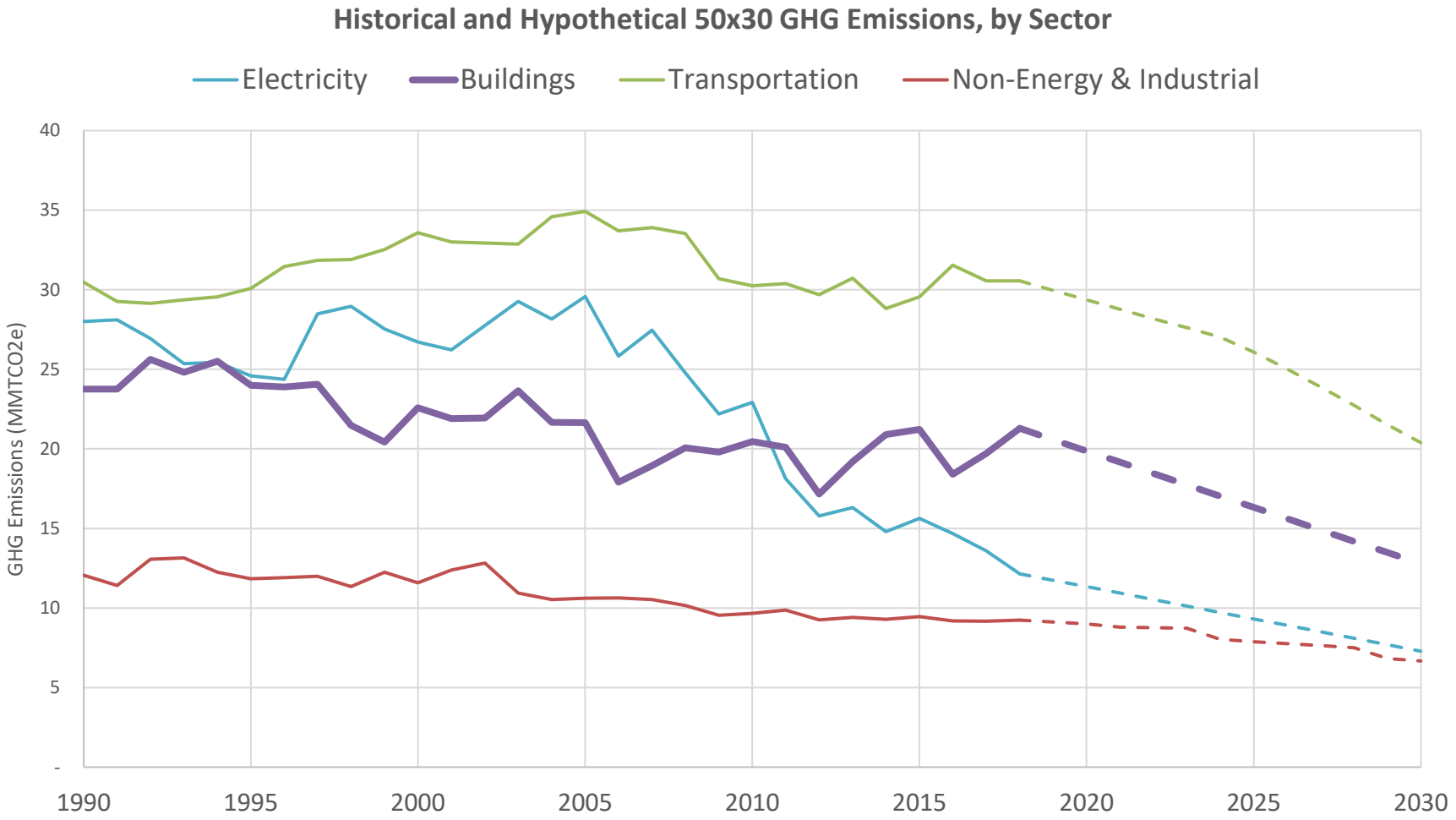
COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENERGY RESOURCES
Patrick Woodcock, Commissioner

Building Energy Code Straw Proposal: Q&A for A Better City

March 2022

Climate context: MA Emissions by Sector

- **Historical:** Building sector emissions have made modest progress; electric sector has made most progress in decreasing emissions
- **Going forward**: Need reductions across all sectors by 2030 and beyond
- More than **50% of emissions reductions we need to cut by 2050** will come from personal vehicles and residential space heating

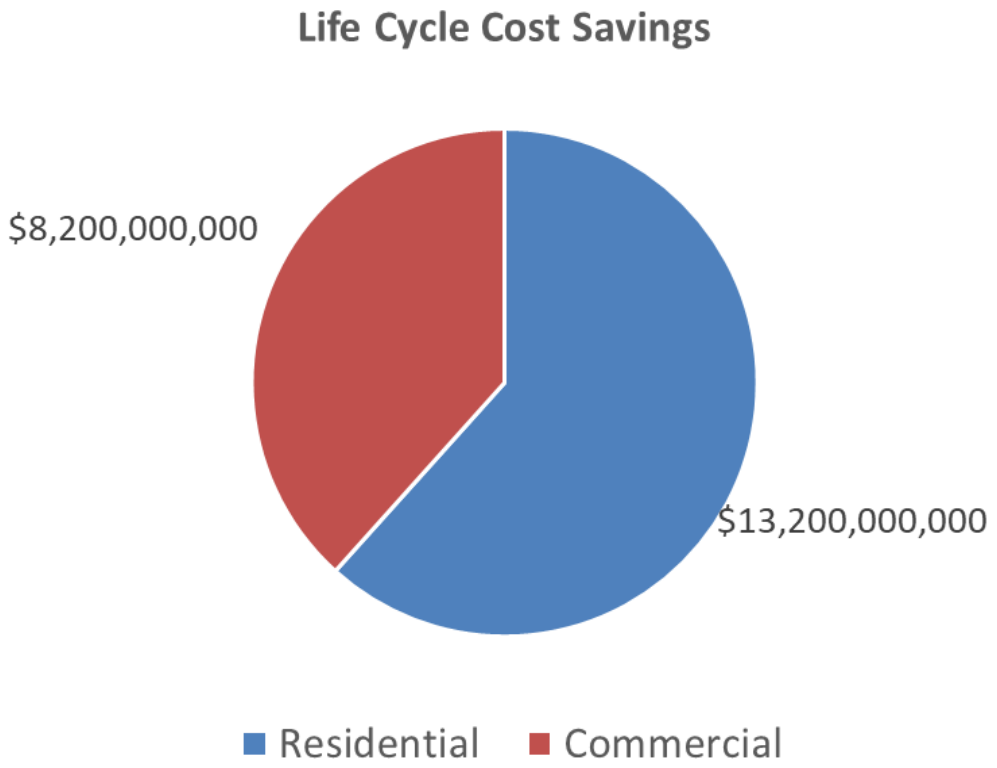


DOER Straw Proposal – Economic and Emissions Impact

- **DOER is proposing two updates:**
  - Update Stretch Energy Code, align with timing of the base energy code update
  - Issue new Specialized Opt-in Code as required by 2021 Climate Roadmap legislation by Dec 2022

- **500,000* tons/year** of GHG reductions in 2030,
  - rising to 694,000 tons/year by 2035
  - Other economic, health, resiliency and grid benefits

- **Over $21 Billion** in life cycle cost savings (combined construction and operating costs)



*Note: Emissions reduction and cost savings forecasts are conservative as they currently do not account for any solar PV additions to new construction or methane leakage from natural gas supply and use.

Starting in 2023 – 3 Energy Code options:

This straw proposal includes an update to the stretch code alongside the new specialized stretch option for Municipalities

Base Code
(10th Edition of MA Building Code)

- New Buildings in towns and cities that have not adopted a stretch code
- 52 communities
- BBRS update effective in 2023

Stretch Code
(Update)

- New Buildings in towns and cities that adopted, including all green communities
- 299 communities
- DOER update effective in 2023

Specialized Opt-in
(New Code Option)

- New Buildings in towns and cities that choose to opt-into this code
- Available for adoption Dec 2022

Straw Proposal for Comment

DOER is seeking comments on its Straw Proposal updating the Stretch Energy Code and Proposing the new, Specialized Stretch Energy Code.

DOER highly encourages written comments be submitted electronically to **stretchcode@mass.gov** with the subject line “Stretch Code Straw Proposal Comments”. Responses will be accepted until 5 pm on **March 9, 2022**. Written comments may also be submitted via mail to the Department of Energy Resources, 100 Cambridge Street, Suite 1020, Boston, Ma 02114, attention Nina Mascarenhas.

ABC Questions

Question

What additional opportunities will there be for comments beyond the first date (currently March 9th)?

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Massachusetts Department of Energy Resources

Expected Timeline for code adoption

	Winter 2022	Spring 2022	Summer 2022	Fall 2022	Winter/Spring 2023	Summer 2023 and beyond
Updated Base Code	Draft on BBRS 10th edition code webpage		BBRS Public hearing on 10th edition	BBRS vote on final 10th edition	**Effective Jan. 2023** as part of 10th edition Code (MA IECC 2021)	
Updated Stretch Code	Outreach, public hearings, and comments on straw proposal	Draft code language available for public comment	Public hearings on draft code	Finalize code proposal & Publish Code	**Effective Jan. 2023** to align with 10th edition	Phase-in HERS requirements in Dec 2023
New Specialized Opt-in Code	Outreach, public hearings, and comments on straw proposal	Draft code language available for public comment	Public hearings on draft code	Finalize code proposal & Publish Code	**Finalized Dec. 2022 -** Municipal adoption begins	Likely effective dates - July 1, 2023, Jan 1, 2024

ABC Questions

Question

Can you describe the Targeted Performance Pathway and Relative Performance Pathway compliance processes in more detail? What will be required of developers?

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Proposed Stretch Code: Pathways

DOER PROPOSAL: Five Pathways for Code Compliance depending on building use type:

- Prescriptive Pathway (Small buildings <20,000 sf only)
- Targeted Performance Pathway (Required for Offices & Schools, Option for Multi-family)
- Relative Performance Pathway (High ventilation and other buildings)
- Passivehouse (Option for all building types)
- HERS (Option for Multi-family)

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Proposed Stretch Code: Current/Proposed

Pathway	Current	Proposed
Prescriptive	IECC 2018 (MA amended)	IECC 2021 plus MA **additional commercial requirements**: air tightness, windows, ventilation, thermal bridging
Targeted Performance	Not an option	TEDI – Thermal Energy Demand Intensity limits by building type and size for Schools, Offices and Option for Multi-family. **Add'l commercial requirements** re: air tightness and widows/walls
Relative Performance	2013 ASHRAE (mandatory over 100,000 sf)	2019 ASHRAE App G plus MA **additional commercial requirements** (air tightness, etc) allowed for a) complex, high ventilation buildings and b) buildings not required to follow TEDI
Passivehouse	Optional for all types	Optional for all types
HERS	Option for Multi-family (HERS 55)	Option for Multi-family (HERS 42/45) effective in Dec 2023

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Proposed Stretch Code: Add'l Requirements

	Current Base & Stretch	Updated Stretch & Specialized
Envelope UA maximum	Mandatory – all commercial buildings	Improved for buildings with regular walls and accommodation for curtainwall buildings
Air infiltration	0.4 cfm/sf at 75 Pa	0.25 cfm/sf at 75 Pa
Ventilation Energy Recovery	Many exceptions which allow no energy recovery, otherwise up to 50% effectiveness	Largely reduces exceptions, generally 80% effectiveness
Electrification of space heating	Optional	High ventilation buildings: Partial electrification mandatory, all other buildings: optional

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Proposed Stretch Code: Accommodation for Curtain wall

- Envelope performance backstop
  - Will be somewhat strengthened from current code
  - However, for curtain wall construction – will maintain about current level to accommodate builder preference

- Additional requirements if using curtainwall - demonstrate embodied carbon reduction from a choice of options
  - Low carbon concrete
  - Carbon sequestering materials (e.g. wood fibre-board, mass timber)
  - Recycled materials (e.g. Foamglass)
  - Reused materials/building reuse

ABC Questions

Question

Will you share more detail on the “least-cost decarbonization” analysis conducted by SWA, BRA, Buro Happold, and Consigli?

a. How was the TEDI limit developed?

b. What data supported the cost analysis

What data was used in the large office and office/lab analysis to determine an achievable TEDI and associated cost impacts?

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12 Building types for in-depth analysis

- Small office
- Large office
- Office-lab
- Elementary school
- High school
- High rise multi-family tower
- 4 story multi-family
- Multi-family mid-rise podium
- 6-unit multi-family
- Townhouse
- Single family Small
- Single family Large






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Commercial Analysis Approach

1. Identify representative projects for each building type, fuel source, glazing approach

2. Model base code and Passivehouse scenarios to bracket construction and energy costs

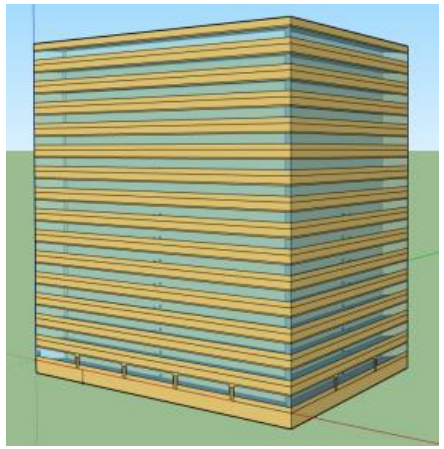
3. Iterate and stress-test designs with a focus on reducing heating loads (emissions) to find 'optimized' performance targets for code

4. Detailed pricing of each building type leading to building case studies

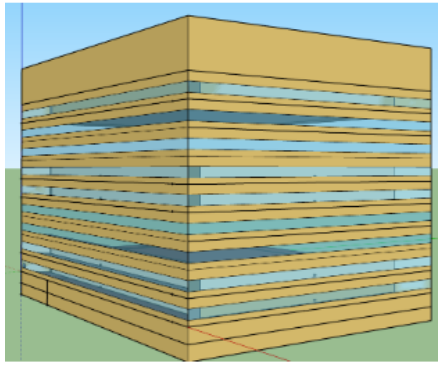
Baseline and improved scenarios

1 2

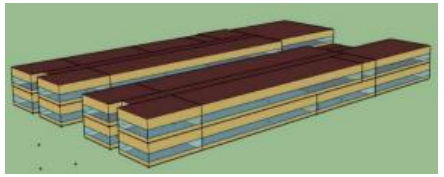
Category	Building Type	Small Office	Large Office	Office/Lab	Primary School	Secondary School
Baseline	IECC 2018	x			x	
	10% Stretch		x	x		x
Improved	Proposed - Gas Heat	x	x	x	x	x
	Proposed - Electric Heat	x	x	x	x	x
	Passive House - Gas Heat	x	x	x	x	x
	Passive House Electric Heat	x	x	x	x	x



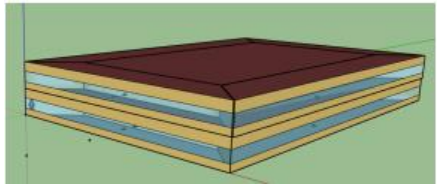
Large Office



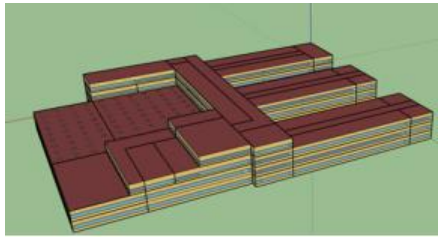
Lab-Office



Primary School



Small Office



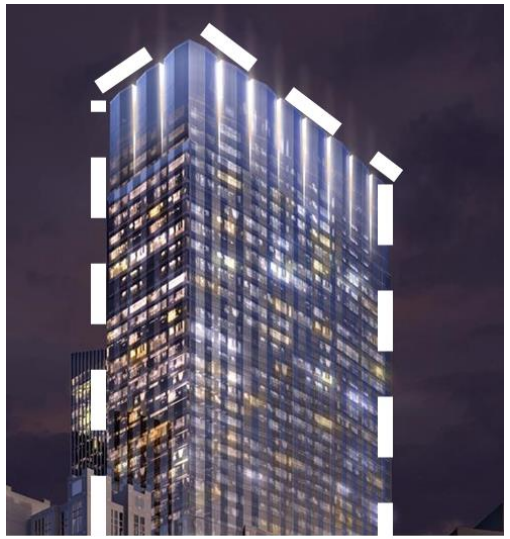
Secondary School

Code baseline and improved models were developed, both gas heated and electric heated. Proposed models used strategy of optimizing envelope and heat recovery improvements to reduce heating thermal demands, reduce HVAC equipment, and improve ease of electrification.

Optimization Process 3

Improved envelope + heat recovery

COST ADD



- Reduced air infiltration
- Wall “R” values
- Window “U” values
- Ventilation heat recovery

Reduced HVAC

COST DEDUCT

- Less distribution systems
- Smaller equipment
- Less rooftop equipment

Massachusetts Department of Energy Resources

Example of detailed cost report

4

MA DOER - Stretch Code Study
Office High Rise - Core & Shell Only
VARIABLE SCOPE ONLY
June 11, 2021

CONSIGLI

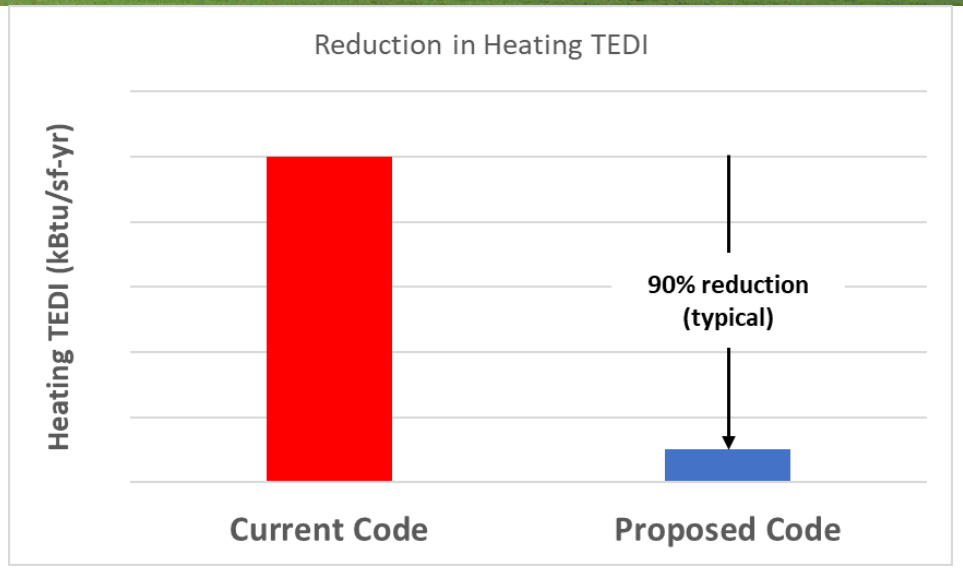
		BASE CASE - 10% Stretch				BASE CASE - 20% Stretch				OPTIMIZED								PASSIVE HOUSE							
		40% Vision		50% Vision		40% Vision		50% Vision		40% Vision				50% Vision				40% Vision				50% Vision			
		Gas Heat		Gas Heat		Gas Heat		Gas Heat		Gas Heat		Electric Heat		Gas Heat		Electric Heat		Gas Heat		Electric Heat		Gas Heat		Electric Heat	
WBS	DESCRIPTION	Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF	
01-10	Testing	-	$ -	-	$ -	-	$ -	-	$ -	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840
05-12	Structural Steel	-	$ -	-	$ -	-	$ -	-	$ -	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400
07-50	Roofing & Sheet Metal	2.21	$ 1,440,000	2.21	$ 1,440,000	2.21	$ 1,440,000	2.21	$ 1,440,000	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400
08-41	Façade	41.38	$ 27,013,850	40.39	$ 26,367,450	41.38	$ 27,013,850	40.39	$ 26,367,450	42.31	$ 27,617,970	42.31	$ 27,617,970	41.82	$ 27,302,850	41.82	$ 27,302,850	51.78	$ 33,802,090	51.78	$ 33,802,090	51.06	$ 33,333,450	51.06	$ 33,333,450
09-21	Drywall	1.71	$ 1,115,040	1.42	$ 929,200	1.71	$ 1,115,040	1.42	$ 929,200	1.71	$ 1,115,040	1.71	$ 1,115,040	1.42	$ 929,200	1.42	$ 929,200	2.08	$ 1,357,440	2.08	$ 1,357,440	1.73	$ 1,131,200	1.73	$ 1,131,200
SUBTOTAL (Architectural)		**45**	**$ 29,568,890**	**44**	**$ 28,736,650**	**45**	**$ 29,568,890**	**44**	**$ 28,736,650**	**47**	**$ 30,656,650**	**47**	**$ 30,656,650**	**46**	**$ 30,155,690**	**46**	**$ 30,155,690**	**57**	**$ 37,083,170**	**57**	**$ 37,083,170**	**56**	**$ 36,388,290**	**56**	**$ 36,388,290**
Back Up Item #		*1*		*2*		*1*		*2*		*3*		*3*		*4*		*4*		*5*		*5*		*6*		*6*	
22-01	Plumbing	0.26	$ 171,360	0.26	$ 171,360	0.26	$ 171,360	0.26	$ 171,360	0.16	$ 102,816	-	$ -	0.16	$ 102,816	-	$ -	0.16	$ 102,816	-	$ -	0.16	$ 102,816	-	$ -
23-01	HVAC	19.33	$ 12,616,609	19.33	$ 12,616,609	11.98	$ 7,817,909	11.98	$ 7,817,909	5.00	$ 3,265,044	6.05	$ 3,950,649	5.00	$ 3,265,044	6.05	$ 3,950,649	5.94	$ 3,880,544	6.99	$ 4,566,149	5.94	$ 3,880,544	6.99	$ 4,566,149
26-01	Electrical	2.63	$ 1,713,600	2.63	$ 1,713,600	2.63	$ 1,713,600	2.63	$ 1,713,600	2.63	$ 1,713,600	3.15	$ 2,056,320	2.63	$ 1,713,600	3.15	$ 2,056,320	2.63	$ 1,713,600	3.15	$ 2,056,320	2.63	$ 1,713,600	3.15	$ 2,056,320
26-02	Photovoltaics	-		0.34	$ 225,000	0.69	$ 450,000	1.08	$ 705,000	-		-		-	$ -	-	$ -	-		-		-	$ -	-	$ -
SUBTOTAL (MEP)		**22**	**$ 14,501,569**	**23**	**$ 14,726,569**	**16**	**$ 10,152,869**	**16**	**$ 10,407,869**	**8**	**$ 5,081,460**	**9**	**$ 6,006,969**	**8**	**$ 5,081,460**	**9**	**$ 6,006,969**	**9**	**$ 5,696,960**	**10**	**$ 6,622,469**	**9**	**$ 5,696,960**	**10**	**$ 6,622,469**
Back Up Item #		*50*		*50*		*51*		*51*		*52*		*53*		*52*		*53*		*54*		*55*		*54*		*55*	
SUBTOTAL		**68**	**$ 44,070,459**	**67**	**$ 43,463,219**	**61**	**$ 39,721,759**	**60**	**$ 39,144,519**	**55**	**$ 35,738,110**	**56**	**$ 36,663,619**	**54**	**$ 35,237,150**	**55**	**$ 36,162,659**	**66**	**$ 42,780,130**	**67**	**$ 43,705,639**	**64**	**$ 42,085,250**	**66**	**$ 43,010,759**
	Indirects Costs 20.00%	13.50	$ 8,814,092	13.32	$ 8,692,644	12.17	$ 7,944,352	11.99	$ 7,828,904	10.95	$ 7,147,622	11.23	$ 7,332,724	10.80	$ 7,047,430	11.08	$ 7,232,532	13.11	$ 8,556,026	13.39	$ 8,741,128	12.89	$ 8,417,050	13.18	$ 8,602,152
TOTAL COST - VARIABLE SCOPES		**81**	**$ 52,884,551**	**80**	**$ 52,155,863**	**73**	**$ 47,666,111**	**72**	**$ 46,973,423**	**66**	**$ 42,885,732**	**67**	**$ 43,996,343**	**65**	**$ 42,284,580**	**66**	**$ 43,395,191**	**79**	**$ 51,336,156**	**80**	**$ 52,446,767**	**77**	**$ 50,502,300**	**79**	**$ 51,612,911**
TOTAL COST - ALL SCOPE		**327**	**$ 213,630,000**	326	$ 212,901,312	319	$ 208,411,560	318	$ 207,718,872	312	$ 203,631,181	314	$ 204,741,792	**311**	**$ 203,030,029**	313	$ 204,140,640	325	$ 212,081,605	327	$ 213,192,216	324	$ 211,247,749	325	$ 212,358,360
	+/- to baseline				$ (728,688)		$ (5,218,440)		$ (5,911,128)		$ (9,998,819)		$ (8,888,208)		$ (10,599,971)		$ (9,489,360)		$ (1,548,395)		$ (437,784)		$ (2,382,251)		$ (1,271,640)
	% change to baseline - on TOTAL COST		NA		-0.34%		-2.44%		-2.77%		-4.68%		-4.16%		-4.96%		-4.44%		-0.72%		-0.20%		-1.12%		-0.60%
	+/- to lowest cost		$ 10,599,971		$ 9,871,283		$ 5,381,531		$ 4,688,843		$ 601,152		$ 1,711,763				$ 1,110,611		$ 9,051,576		$ 10,162,187		$ 8,217,720		$ 9,328,331
	% change to lowest cost - on TOTAL COST		5.22%		4.86%		2.65%		2.31%		0.30%		0.84%		NA		0.55%		4.46%		5.01%		4.05%		4.59%

Proposed Stretch Code: Targeted Performance Path

- What is heating "TEDI":
  - **T**hermal **E**nergy **D**emand **I**ntensity
  - Amount of heating needed over 1 year

- Benefits to low TEDI
  - Easy to electrify
  - Cost effective
  - Low emissions

- Effective pathway to Zero Energy



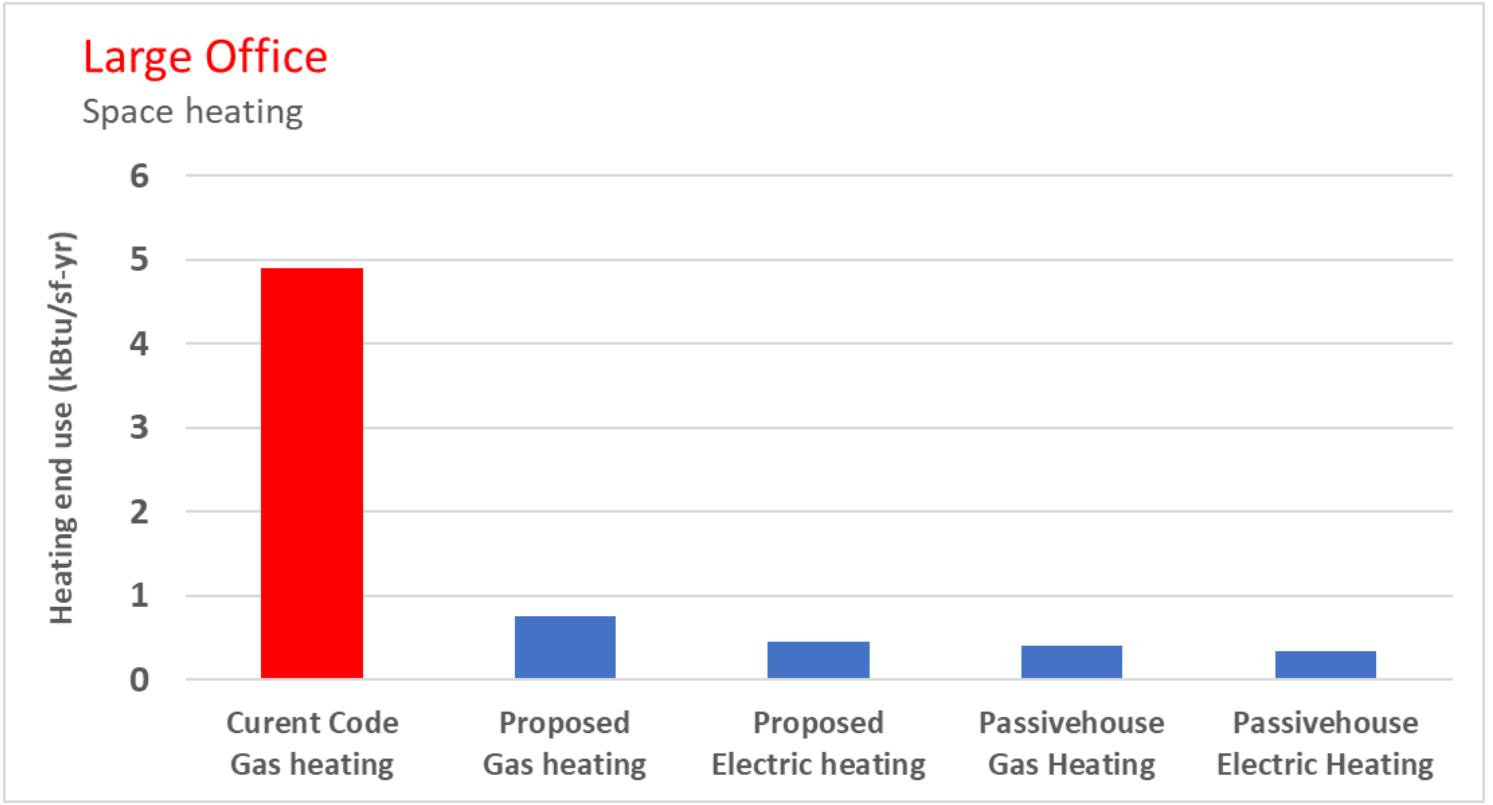
The proposed code reduces heating TEDI by 90% for most buildings

Key Metric – Thermal Energy Demand Intensity (TEDI)

A design approach focused on cost-effective emissions reduction led to a key metric of heating **T**hermal **E**nergy **D**emand **I**ntensity (TEDI). TEDI was first used in codes for Vancouver and Toronto in Canada

Targeting low heating TEDI means:

- Low emissions
- Easy electrification
- Reduced (or elim) fossil fuel
- Improved resiliency
- Improved comfort



With the proposed code, targeting low heating TEDI results in near elimination of space heating end use. Proposed TEDI code path has space heating end use comparable to Passivehouse at lower cost.

Proposed Stretch Code: TEDI Limits

- **When TEDI applies**
  - Schools
  - Office (including town hall, courthouse, etc)
  - Multifamily (including dormitory)

- **Heating TEDI limits (kBtu/sf-yr)**

K-12 School < 100,000-sf	2.4
K-12 School >= 100,000-sf	2.2
Office < 100,000-sf	2.4
Office >= 100,000-sf	1.5
Multifamily	TBD

- **Plus**
  - Cooling TEDI limits
  - Vertical envelope UA backstop
  - Thermal bridge accounting
  - Infiltration limits and testing

Old Colony - affordable Multi-family - Boston

ABC Questions

Question

How confident are you in the technical/financial feasibility of these updates?

Can you provide case studies with different building typologies that provide proof to the real estate community that this can be implemented technically and is financially feasible?

Massachusetts Department of Energy Resources

Example of detailed cost report

4

MA DOER - Stretch Code Study
Office High Rise - Core & Shell Only
VARIABLE SCOPE ONLY
June 11, 2021

CONSIGLI

		BASE CASE - 10% Stretch				BASE CASE - 20% Stretch				OPTIMIZED								PASSIVE HOUSE							
		40% Vision		50% Vision		40% Vision		50% Vision		40% Vision				50% Vision				40% Vision				50% Vision			
		Gas Heat		Gas Heat		Gas Heat		Gas Heat		Gas Heat		Electric Heat		Gas Heat		Electric Heat		Gas Heat		Electric Heat		Gas Heat		Electric Heat	
WBS	DESCRIPTION	Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF		Total Cost 652,800 SF	
01-10	Testing	-	$ -	-	$ -	-	$ -	-	$ -	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840	0.32	$ 210,840
05-12	Structural Steel	-	$ -	-	$ -	-	$ -	-	$ -	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400	0.21	$ 138,400
07-50	Roofing & Sheet Metal	2.21	$ 1,440,000	2.21	$ 1,440,000	2.21	$ 1,440,000	2.21	$ 1,440,000	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400	2.41	$ 1,574,400
08-41	Façade	41.38	$ 27,013,850	40.39	$ 26,367,450	41.38	$ 27,013,850	40.39	$ 26,367,450	42.31	$ 27,617,970	42.31	$ 27,617,970	41.82	$ 27,302,850	41.82	$ 27,302,850	51.78	$ 33,802,090	51.78	$ 33,802,090	51.06	$ 33,333,450	51.06	$ 33,333,450
09-21	Drywall	1.71	$ 1,115,040	1.42	$ 929,200	1.71	$ 1,115,040	1.42	$ 929,200	1.71	$ 1,115,040	1.71	$ 1,115,040	1.42	$ 929,200	1.42	$ 929,200	2.08	$ 1,357,440	2.08	$ 1,357,440	1.73	$ 1,131,200	1.73	$ 1,131,200
SUBTOTAL (Architectural)		**45**	**$ 29,568,890**	**44**	**$ 28,736,650**	**45**	**$ 29,568,890**	**44**	**$ 28,736,650**	**47**	**$ 30,656,650**	**47**	**$ 30,656,650**	**46**	**$ 30,155,690**	**46**	**$ 30,155,690**	**57**	**$ 37,083,170**	**57**	**$ 37,083,170**	**56**	**$ 36,388,290**	**56**	**$ 36,388,290**
Back Up Item #		*1*		*2*		*1*		*2*		*3*		*3*		*4*		*4*		*5*		*5*		*6*		*6*	
22-01	Plumbing	0.26	$ 171,360	0.26	$ 171,360	0.26	$ 171,360	0.26	$ 171,360	0.16	$ 102,816	-	$ -	0.16	$ 102,816	-	$ -	0.16	$ 102,816	-	$ -	0.16	$ 102,816	-	$ -
23-01	HVAC	19.33	$ 12,616,609	19.33	$ 12,616,609	11.98	$ 7,817,909	11.98	$ 7,817,909	5.00	$ 3,265,044	6.05	$ 3,950,649	5.00	$ 3,265,044	6.05	$ 3,950,649	5.94	$ 3,880,544	6.99	$ 4,566,149	5.94	$ 3,880,544	6.99	$ 4,566,149
26-01	Electrical	2.63	$ 1,713,600	2.63	$ 1,713,600	2.63	$ 1,713,600	2.63	$ 1,713,600	2.63	$ 1,713,600	3.15	$ 2,056,320	2.63	$ 1,713,600	3.15	$ 2,056,320	2.63	$ 1,713,600	3.15	$ 2,056,320	2.63	$ 1,713,600	3.15	$ 2,056,320
26-02	Photovoltaics	-		0.34	$ 225,000	0.69	$ 450,000	1.08	$ 705,000	-		-		-	$ -	-	$ -	-		-		-	$ -	-	$ -
SUBTOTAL (MEP)		**22**	**$ 14,501,569**	**23**	**$ 14,726,569**	**16**	**$ 10,152,869**	**16**	**$ 10,407,869**	**8**	**$ 5,081,460**	**9**	**$ 6,006,969**	**8**	**$ 5,081,460**	**9**	**$ 6,006,969**	**9**	**$ 5,696,960**	**10**	**$ 6,622,469**	**9**	**$ 5,696,960**	**10**	**$ 6,622,469**
Back Up Item #		*50*		*50*		*51*		*51*		*52*		*53*		*52*		*53*		*54*		*55*		*54*		*55*	
SUBTOTAL		**68**	**$ 44,070,459**	**67**	**$ 43,463,219**	**61**	**$ 39,721,759**	**60**	**$ 39,144,519**	**55**	**$ 35,738,110**	**56**	**$ 36,663,619**	**54**	**$ 35,237,150**	**55**	**$ 36,162,659**	**66**	**$ 42,780,130**	**67**	**$ 43,705,639**	**64**	**$ 42,085,250**	**66**	**$ 43,010,759**
	Indirects Costs 20.00%	13.50	$ 8,814,092	13.32	$ 8,692,644	12.17	$ 7,944,352	11.99	$ 7,828,904	10.95	$ 7,147,622	11.23	$ 7,332,724	10.80	$ 7,047,430	11.08	$ 7,232,532	13.11	$ 8,556,026	13.39	$ 8,741,128	12.89	$ 8,417,050	13.18	$ 8,602,152
TOTAL COST - VARIABLE SCOPES		**81**	**$ 52,884,551**	**80**	**$ 52,155,863**	**73**	**$ 47,666,111**	**72**	**$ 46,973,423**	**66**	**$ 42,885,732**	**67**	**$ 43,996,343**	**65**	**$ 42,284,580**	**66**	**$ 43,395,191**	**79**	**$ 51,336,156**	**80**	**$ 52,446,767**	**77**	**$ 50,502,300**	**79**	**$ 51,612,911**
TOTAL COST - ALL SCOPE		**327**	**$ 213,630,000**	326	$ 212,901,312	319	$ 208,411,560	318	$ 207,718,872	312	$ 203,631,181	314	$ 204,741,792	**311**	**$ 203,030,029**	313	$ 204,140,640	325	$ 212,081,605	327	$ 213,192,216	324	$ 211,247,749	325	$ 212,358,360
	+/- to baseline				$ (728,688)		$ (5,218,440)		$ (5,911,128)		$ (9,998,819)		$ (8,888,208)		$ (10,599,971)		$ (9,489,360)		$ (1,548,395)		$ (437,784)		$ (2,382,251)		$ (1,271,640)
	% change to baseline - on TOTAL COST		NA		-0.34%		-2.44%		-2.77%		-4.68%		-4.16%		-4.96%		-4.44%		-0.72%		-0.20%		-1.12%		-0.60%
	+/- to lowest cost		$ 10,599,971		$ 9,871,283		$ 5,381,531		$ 4,688,843		$ 601,152		$ 1,711,763				$ 1,110,611		$ 9,051,576		$ 10,162,187		$ 8,217,720		$ 9,328,331
	% change to lowest cost - on TOTAL COST		5.22%		4.86%		2.65%		2.31%		0.30%		0.84%		NA		0.55%		4.46%		5.01%		4.05%		4.59%

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Primary School – Costs (TEDI path)

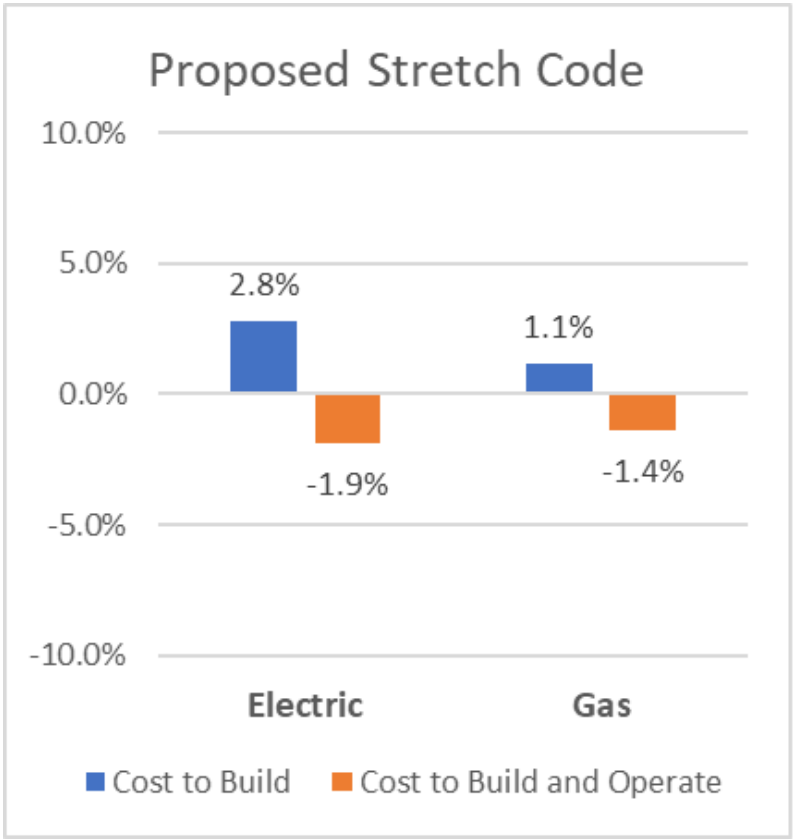
No MassSave or MSBA or other incentives included

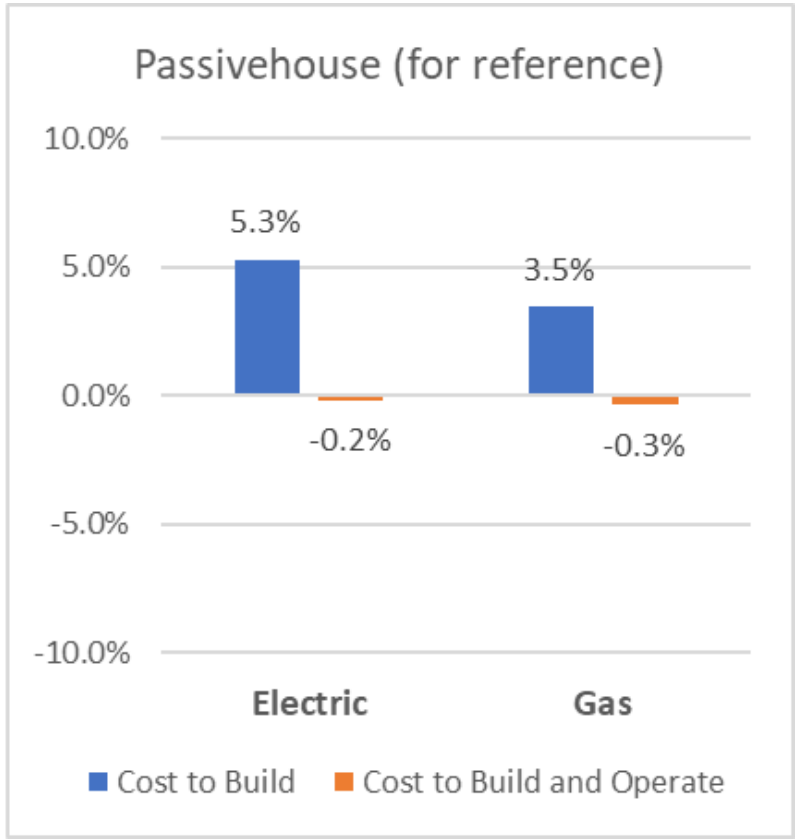
- Cost to Build

  1.1% to 2.8% more

- Cost to Build and Operate (50 yr)

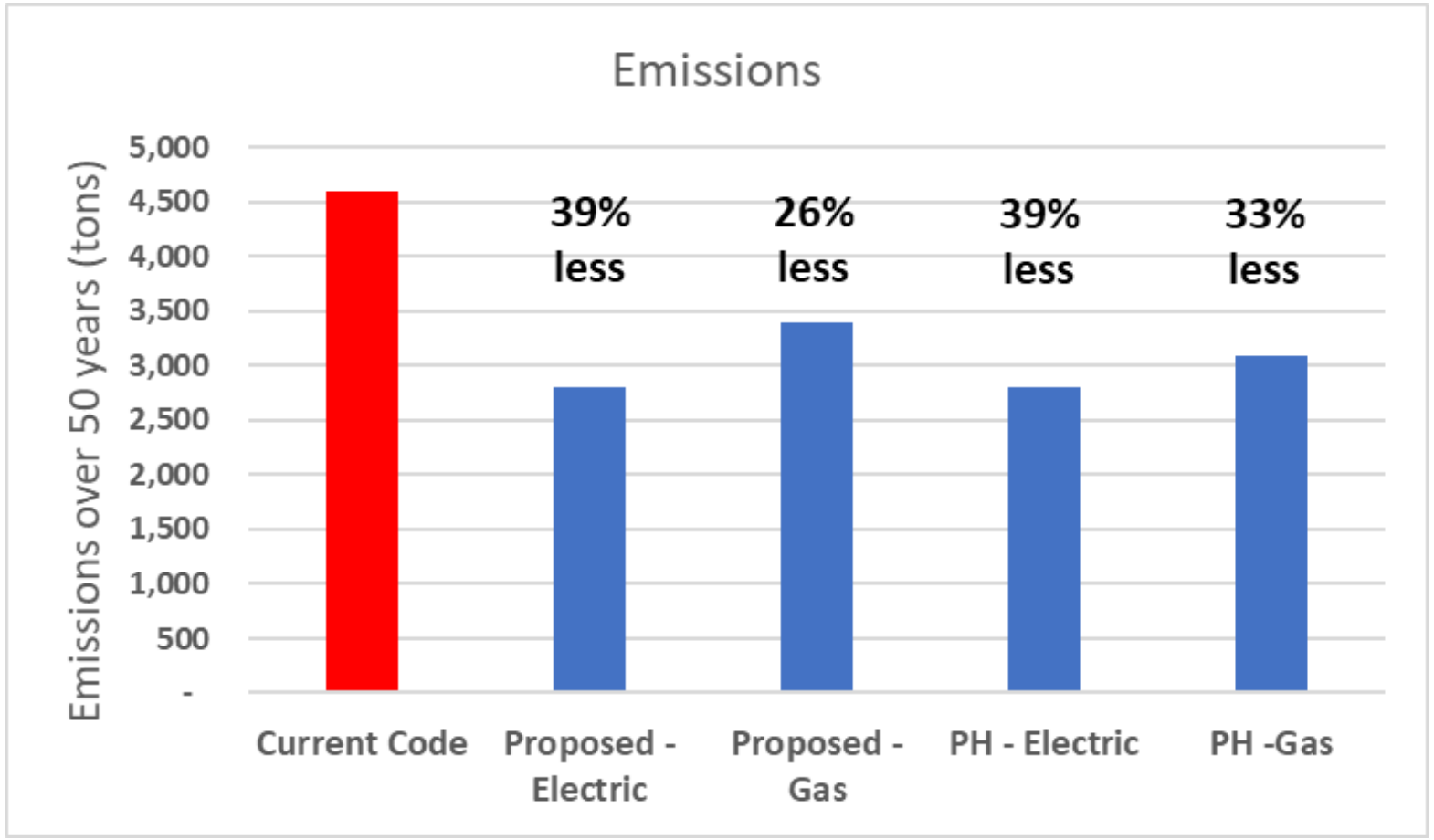
  1.4% to 1.9% less





Primary School - Emissions

- Emission reduction
  26% to 39%
- About 90% less heating demand
- Electrical advantage



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Secondary School – Costs (TEDI path)

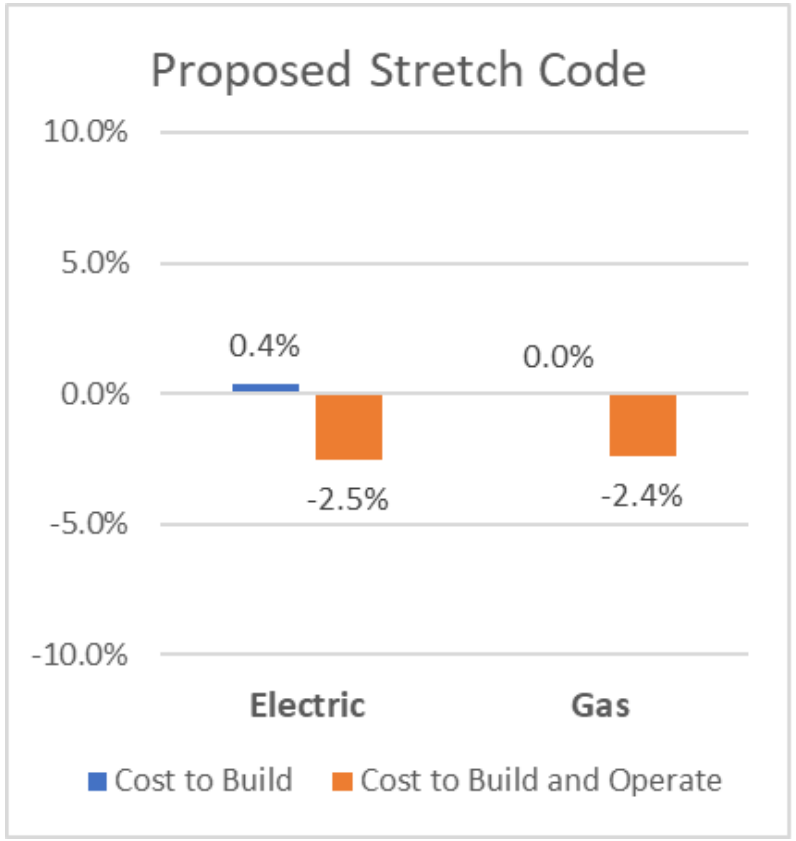
No MassSave or MSBA or other incentives included

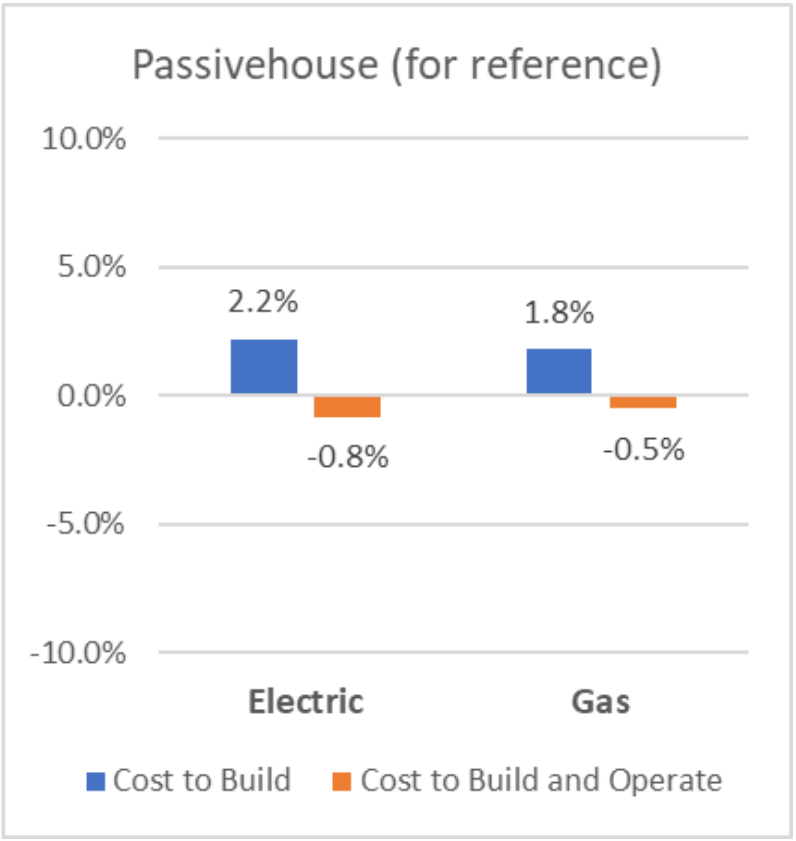
- Cost to Build

  0% to 0.4% more

- Cost to Building and Operate (50 yr)

  2.4% to 2.5% less





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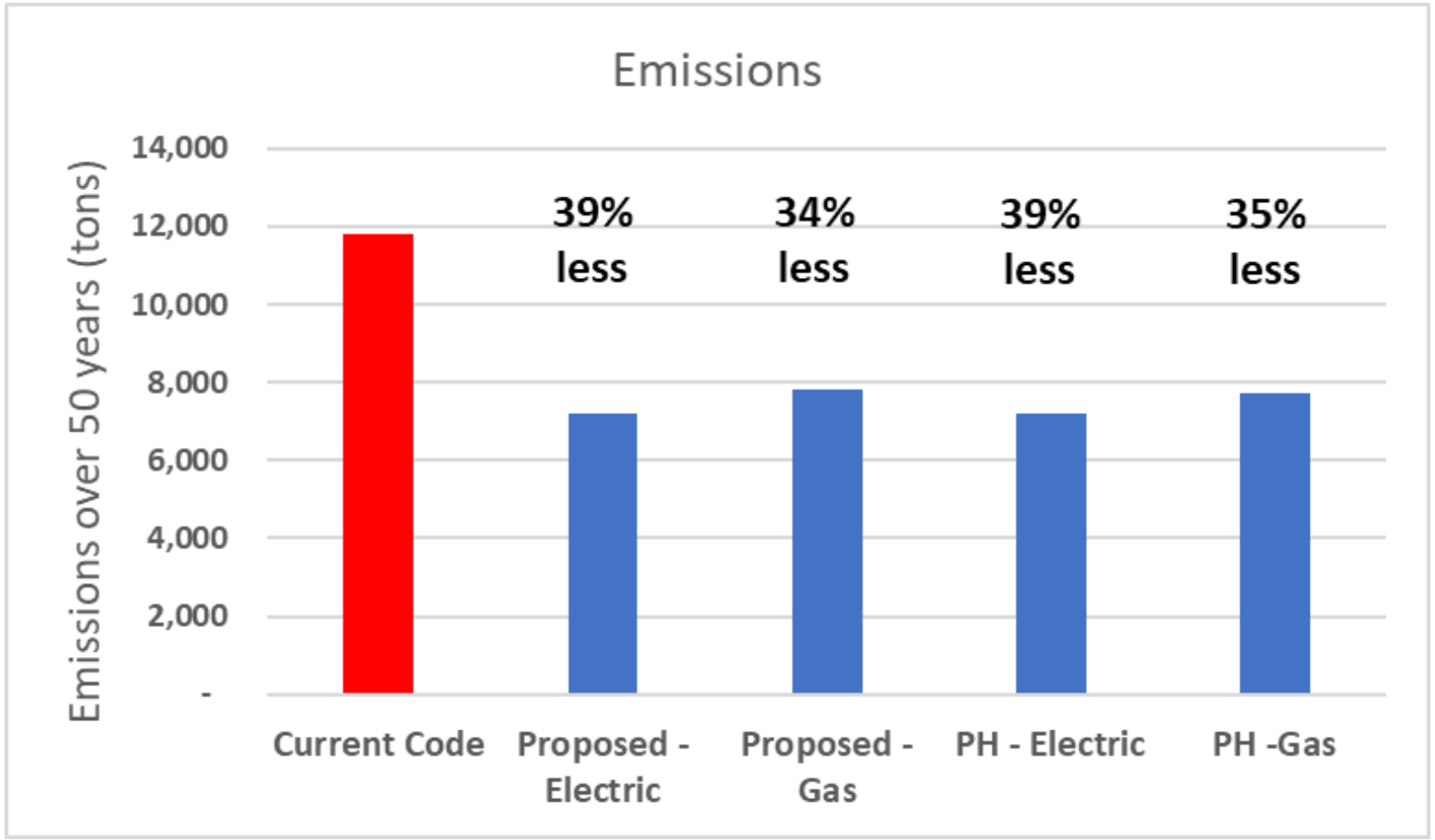
Secondary School - Emissions

- Emission reduction
  34% to 39%
- About 90% less heating demand
- Electric advantage



Small Office – Costs (TEDI path)

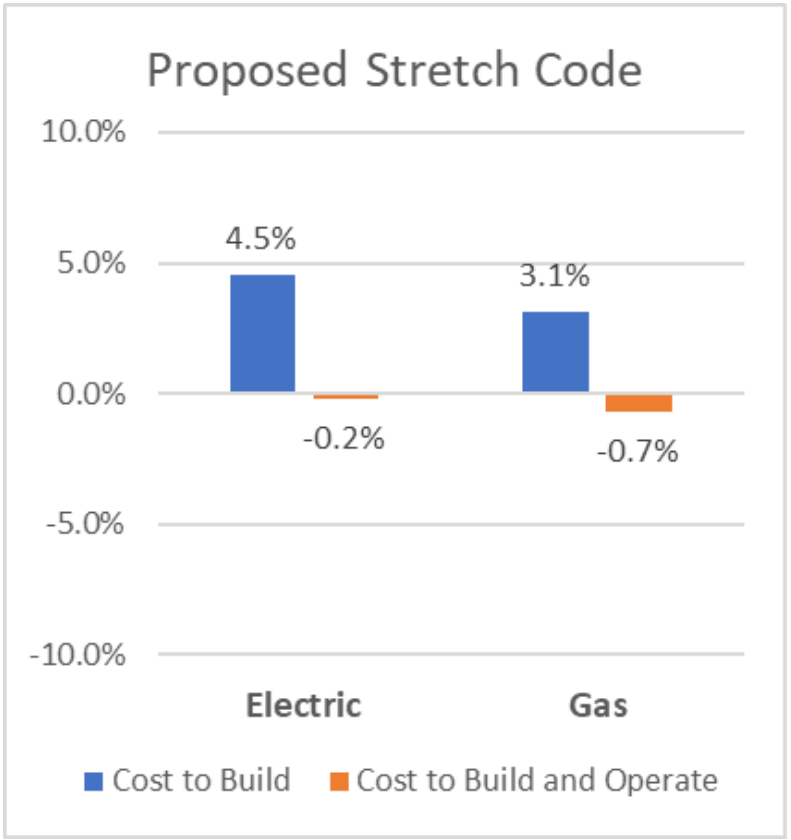
No MassSave or other incentives included

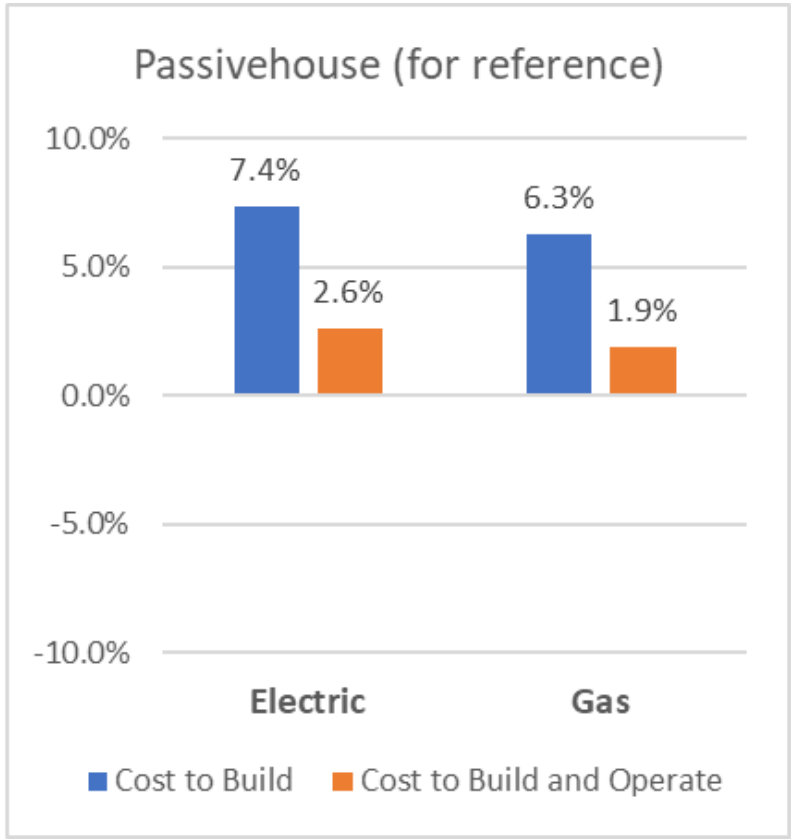
- Cost to Build

  3.1% to 4.5% more

- Cost to Build and Operate (50 yr)

  0.2% to 0.7% less

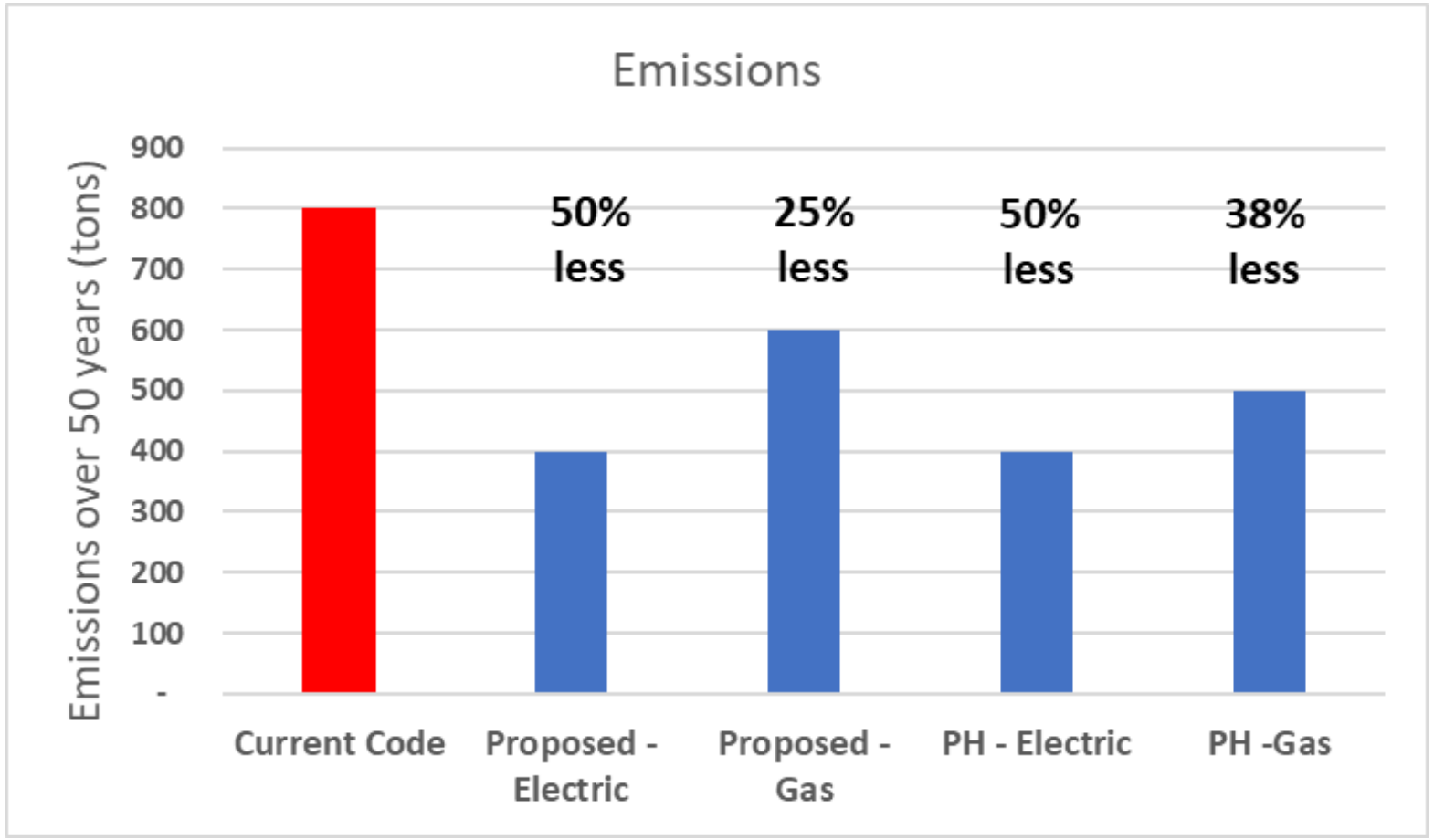




Small Office - Emissions

- Emission reduction

  25% to 50%
- About 90% less heating demand
- Big electric advantage



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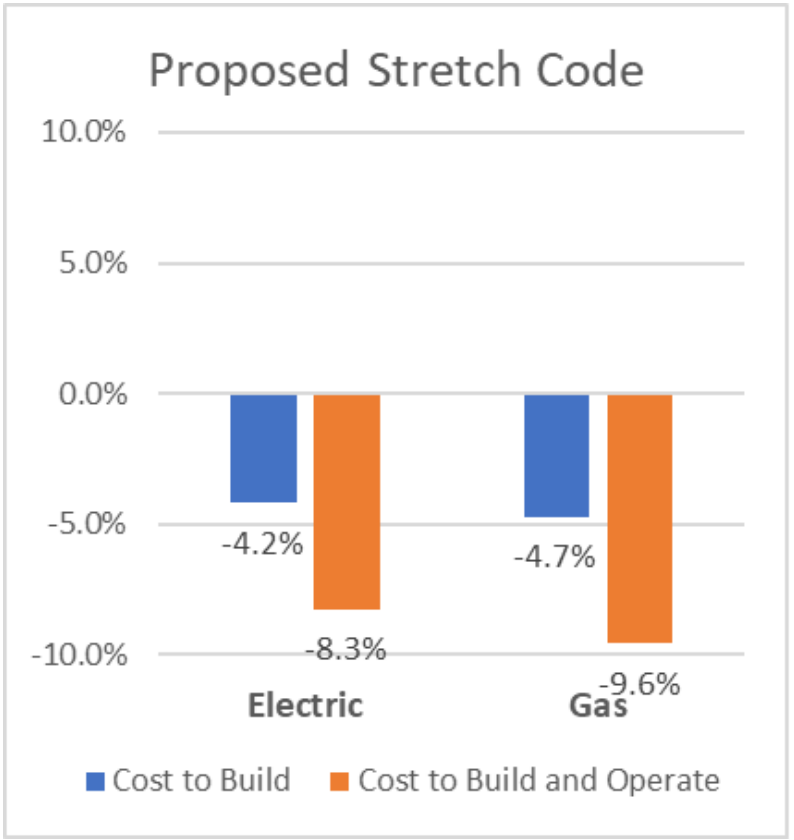
Large Office – Costs (TEDI path)

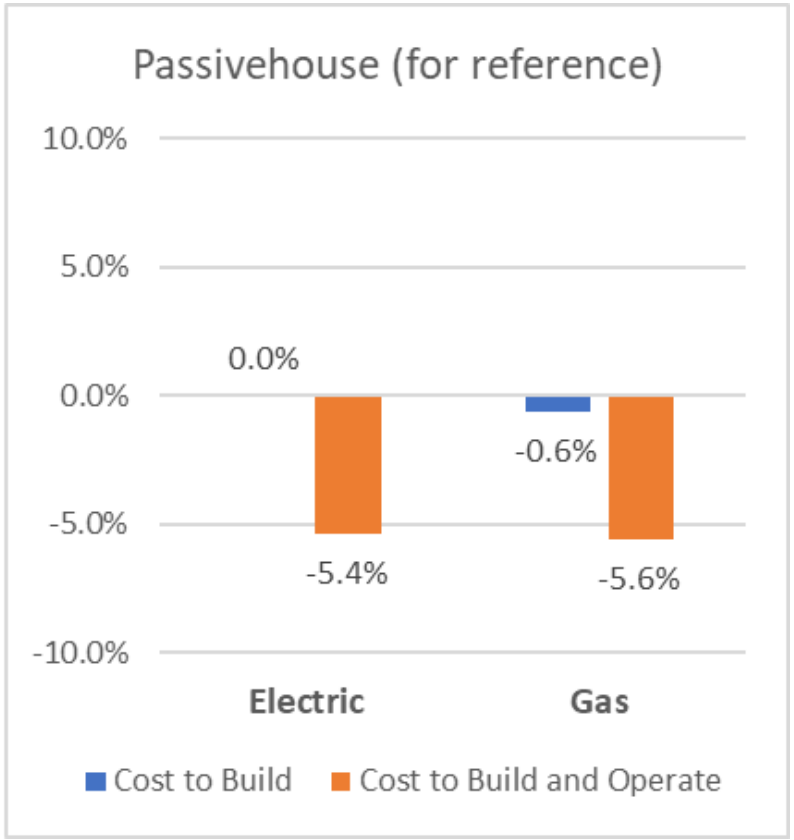
No MassSave or other incentives included

- Cost to Build

  4.2% to 4.7% <u>less</u>
- Cost to Build and Operate (50 yr)

  8.3% to 9.6% less
- Envelope
  - ➢ All curtain wall





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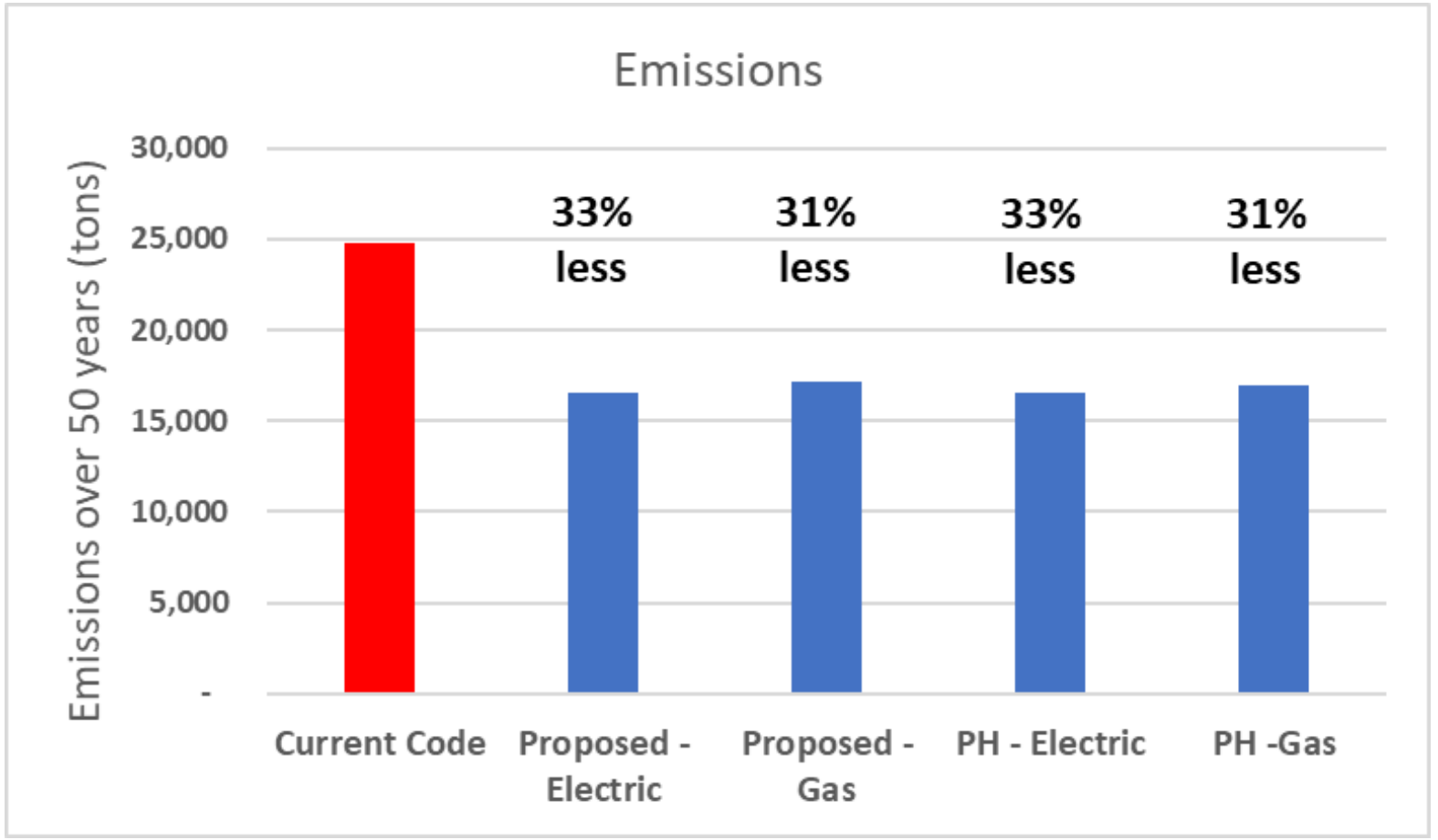
Large Office - Emissions

- Emission reduction
  31% to 33%
- About 90% less heating demand
- Electric advantage



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Office/Lab – Costs (MA ASHRAE path)

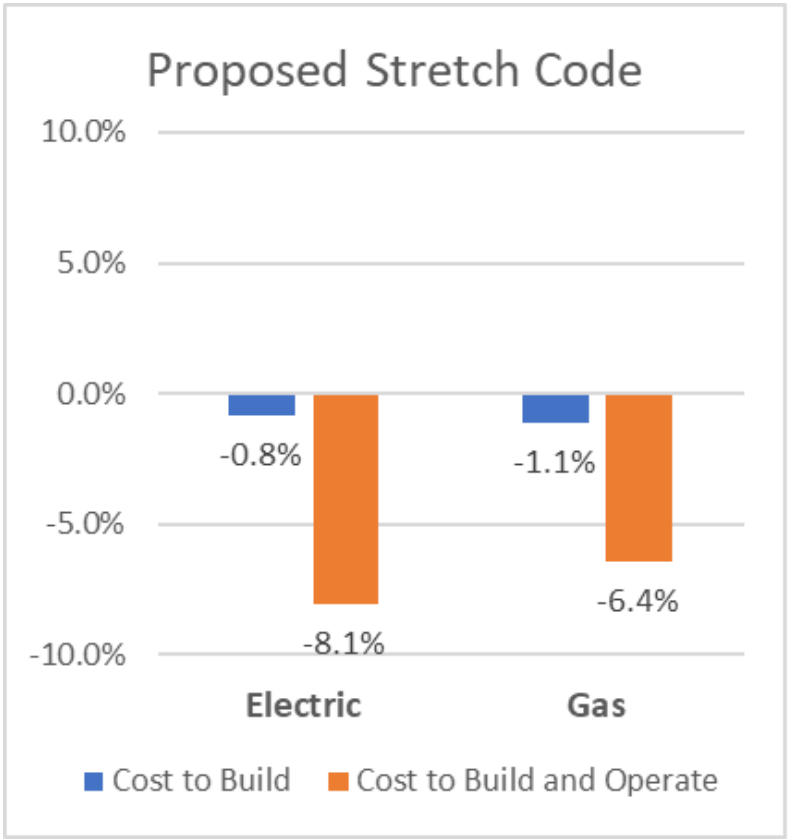
No MassSave or other incentives included

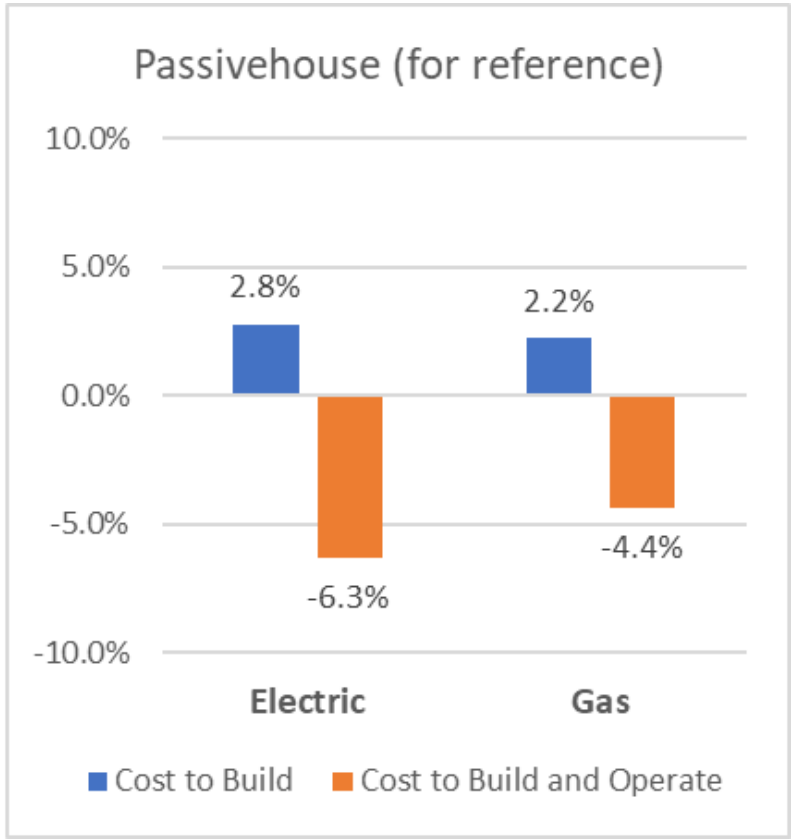
- Cost to Build

  0.8% to 1.1% less
- Cost to Building and Operate (50 yr)

  6.4 to 8.1% less
- Envelope
  - All curtain wall

ow





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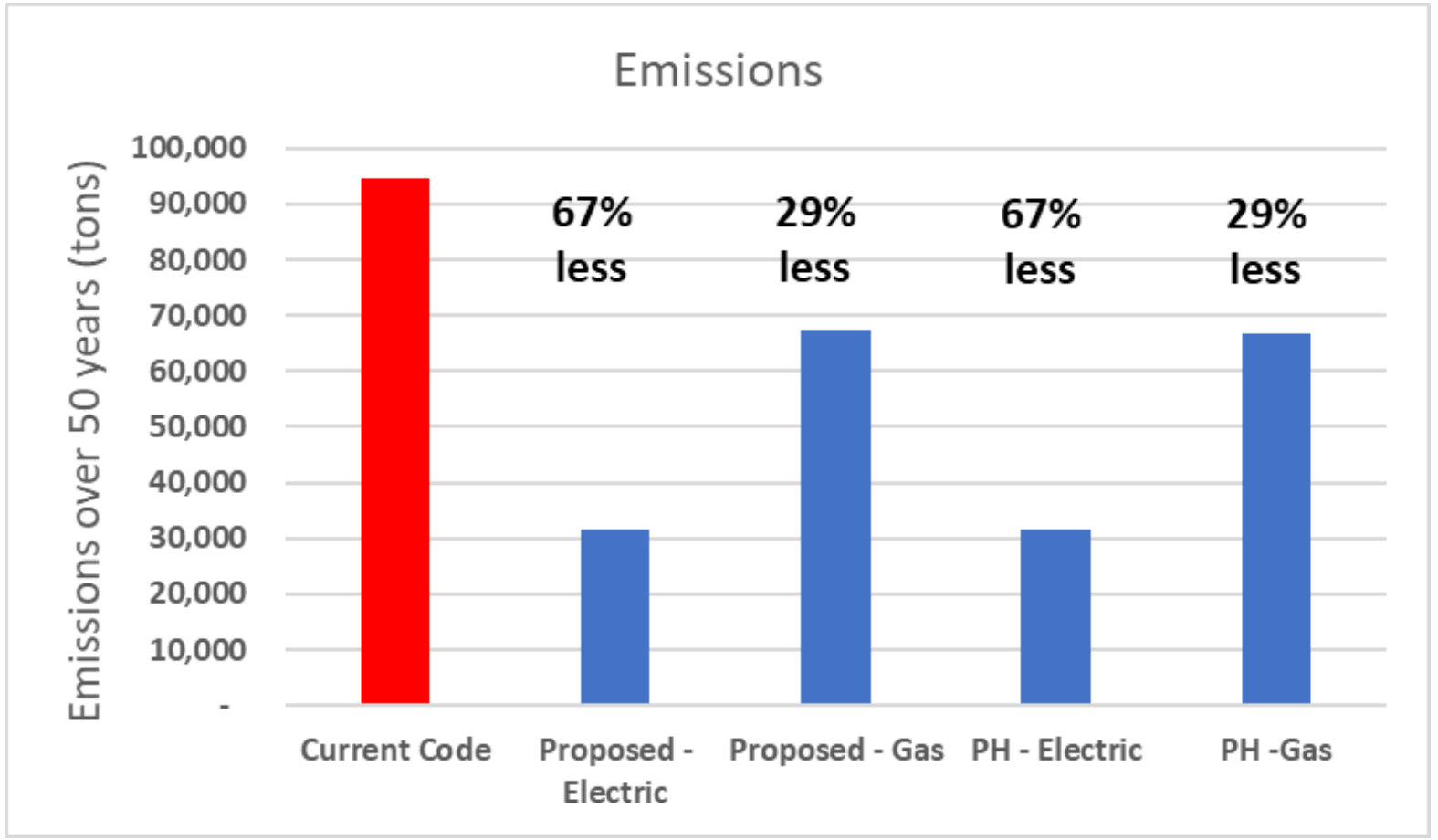
Office/Lab - Emissions

- Emission reduction
  29% to 67%
- About 60% less heating demand
- Electric advantage



ABC Questions

Question

What impacts have the Toronto and Vancouver codes with TEDI metrics had on commercial real estate development? Are there lessons learned that were incorporated into this proposal?

Beyond cost and GHG, what impacts do you anticipate the curtain wall, air infiltration, thermal bridging, and electrification-ready requirements will have on development in Massachusetts?

- Note: What would be good to understand here is whether the workforce/supply chain/market are prepared for these options

ABC Questions

Question

What will be the process for cities/towns opting into the new specialized stretch code?

If a City adopts it, is that adopting within Green Community and associated funding opportunities or outside of it?

If outside of it, will there be funding opportunities for cities and towns associated with the adoption?

If there is opposition to a city/town opting into the high performance stretch code, what will be the process for this opposition?

If a municipality opts into the Specialized Stretch Code, what does that mean for future code updates?

ABC Questions

Question

How does the stretch codes development relate to the City of Boston's zero net carbon zoning standard?

a. What regulation would pre-emp what?

What retrofit threshold is triggered by each code – base, stretch and specialized stretch?

Specialized Opt-in Code (Net Zero) - Commercial

Large Multi-Family → Passive House → Electric Heat or Electrification ready

All other Commercial Building Types →

- Passive House → All Electric or Electrification ready
- Gas or other fossil fuel → All stretch code efficiency requirements → Solar on roof where feasible → Electrification-ready (pre-wiring)
- All-Electric → All Stretch code efficiency requirements