PRESERVATION PRIORITIES TASK FORCE

NATIONAL PRESERVATION PARTNERS NETWORK

National Trust for Historic Preservation®

Calculating Carbon Savings from Building Reuse and Retrofit

Jim Lindberg, National Trust for Historic Preservation

Alison Frazee, Boston Preservation Alliance

Lori Ferriss, Goody Clancy

Larry Strain, Seigel & Strain Architects

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National Trust for Historic Preservation®

Practical tools for preservation organizations and advocates

PRESERVATION PRIORITIES TASK FORCE

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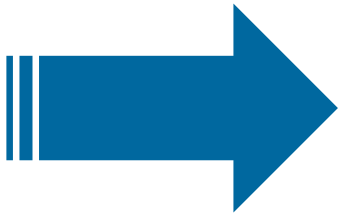
Coordinate efforts

Align communication

Develop resources

Multiply impact



Stronger preservation movement

PRESERVATION PRIORITIES TASK FORCE

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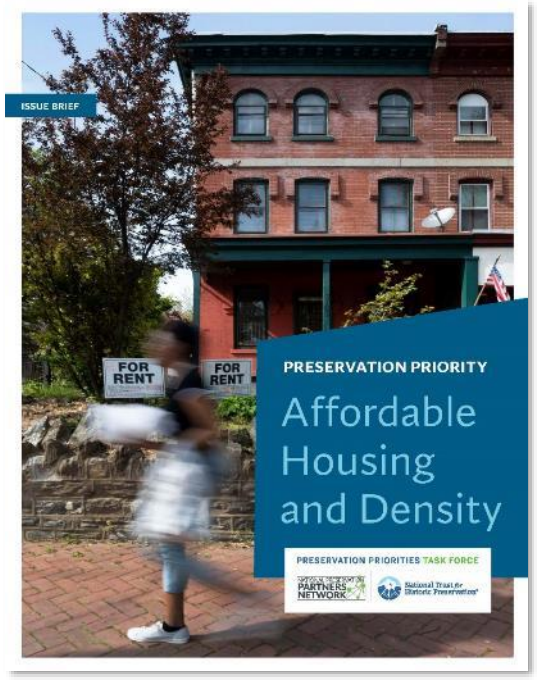
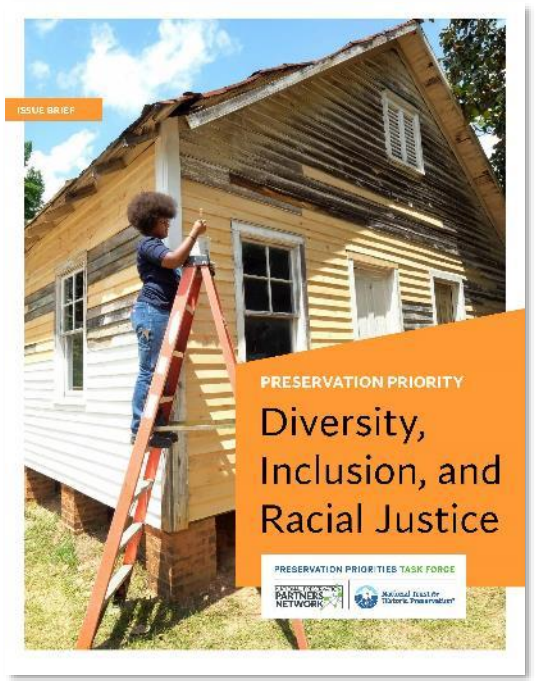
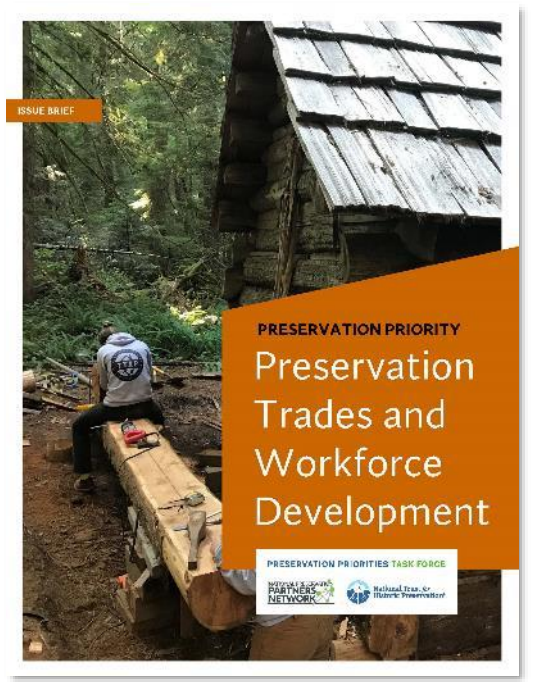
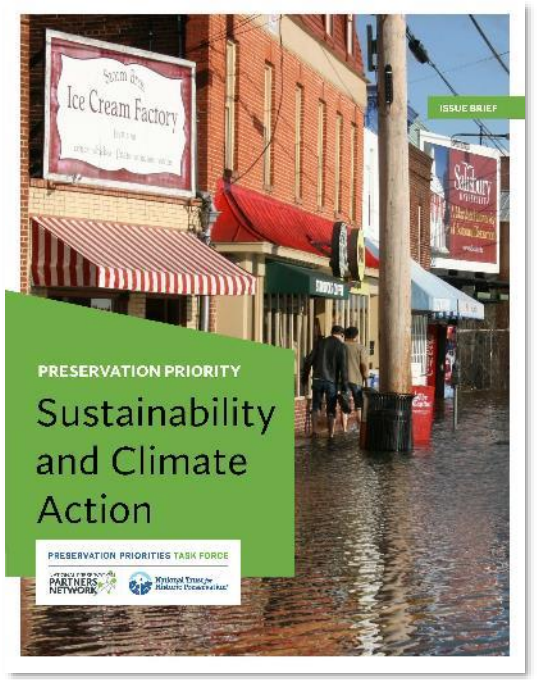
Issue Briefs







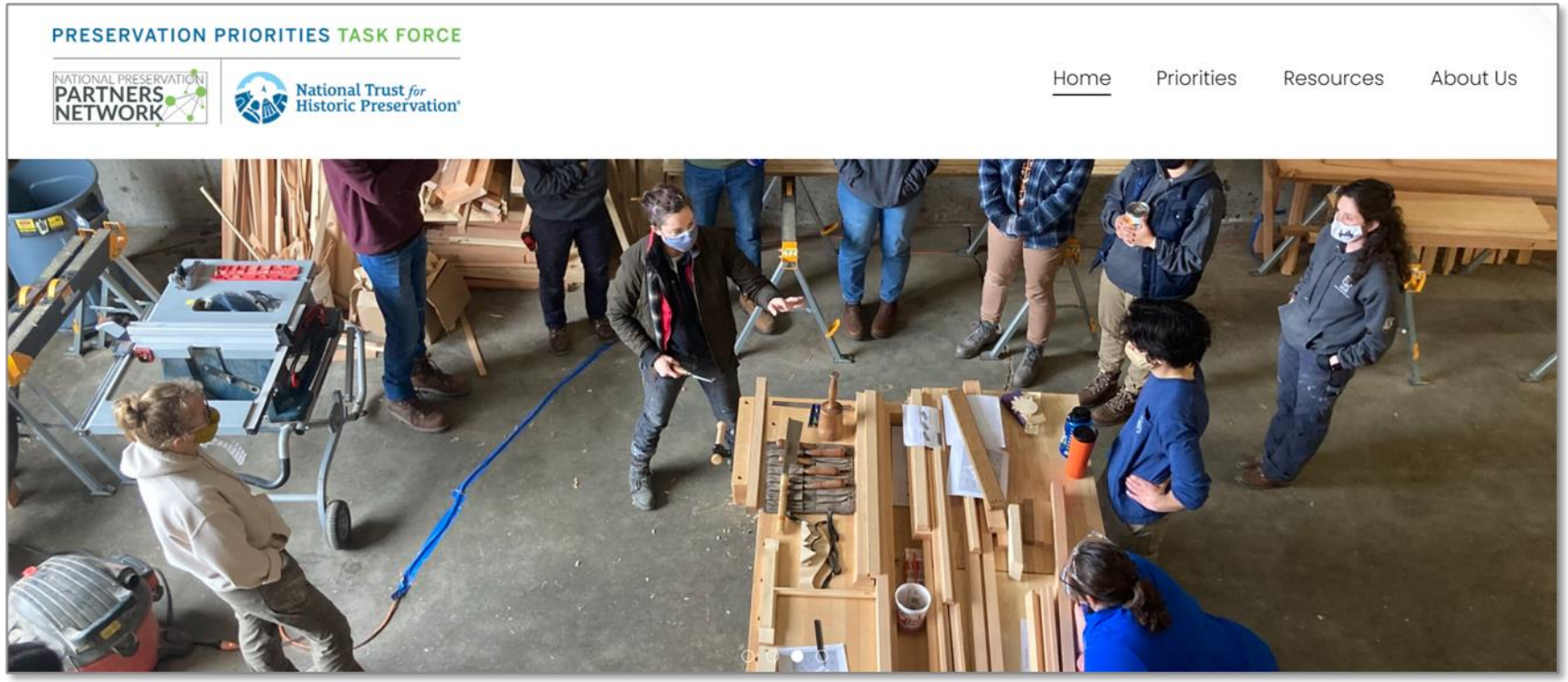


PRESERVATION PRIORITIES TASK FORCE

NATIONAL PRESERVATION PARTNERS NETWORK

National Trust for Historic Preservation

website: **PreservationPriorities.org**



2 Year partnership

4 Working Groups

50+ Volunteer Advocates

PRESERVATION PRIORITIES TASK FORCE

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Supported by

The Moe Family Fund for Statewide and Local Partners

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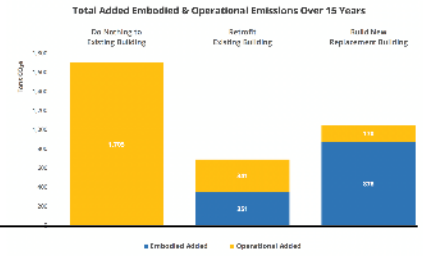
C.A.R.E – Carbon Avoided Retrofit Estimator



Calculating Carbon Savings from Building Reuse and Retrofit

Larry Strain, FAIA

SIEGEL & STRAIN Architects

Lori Ferriss, AIA, PE

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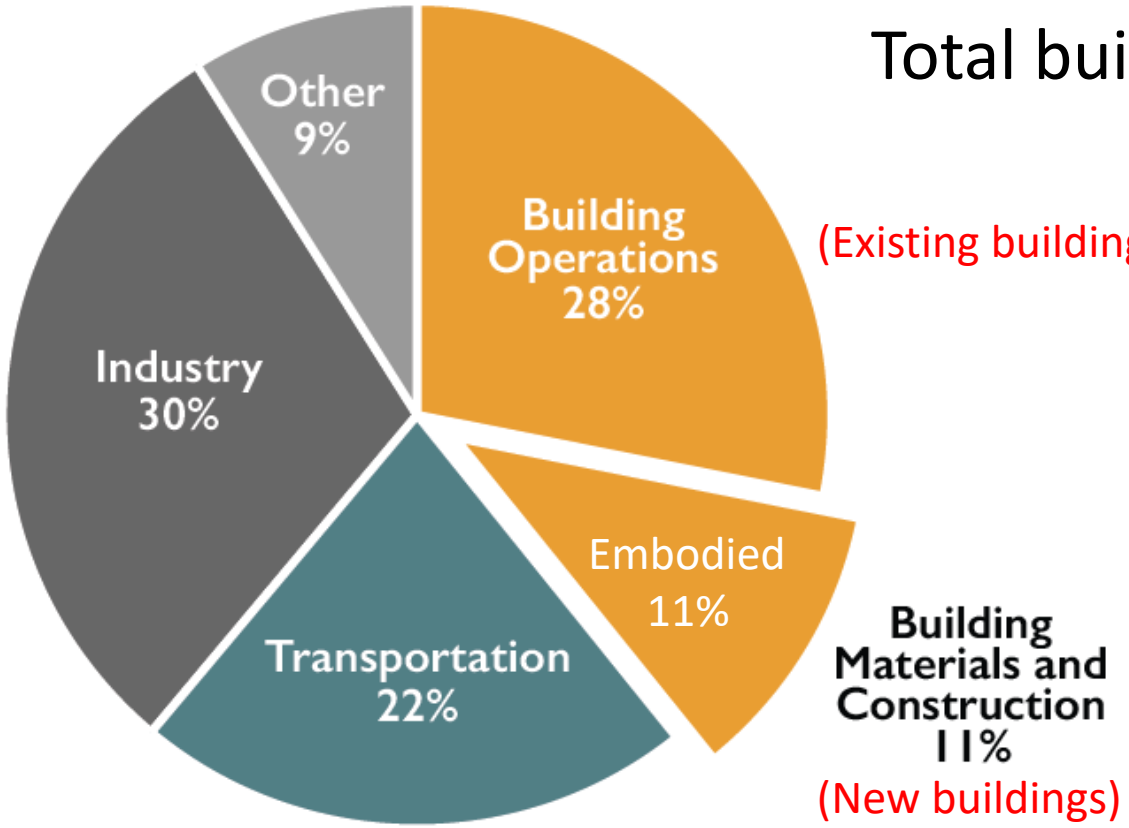
Global CO_2 Emissions by Sector



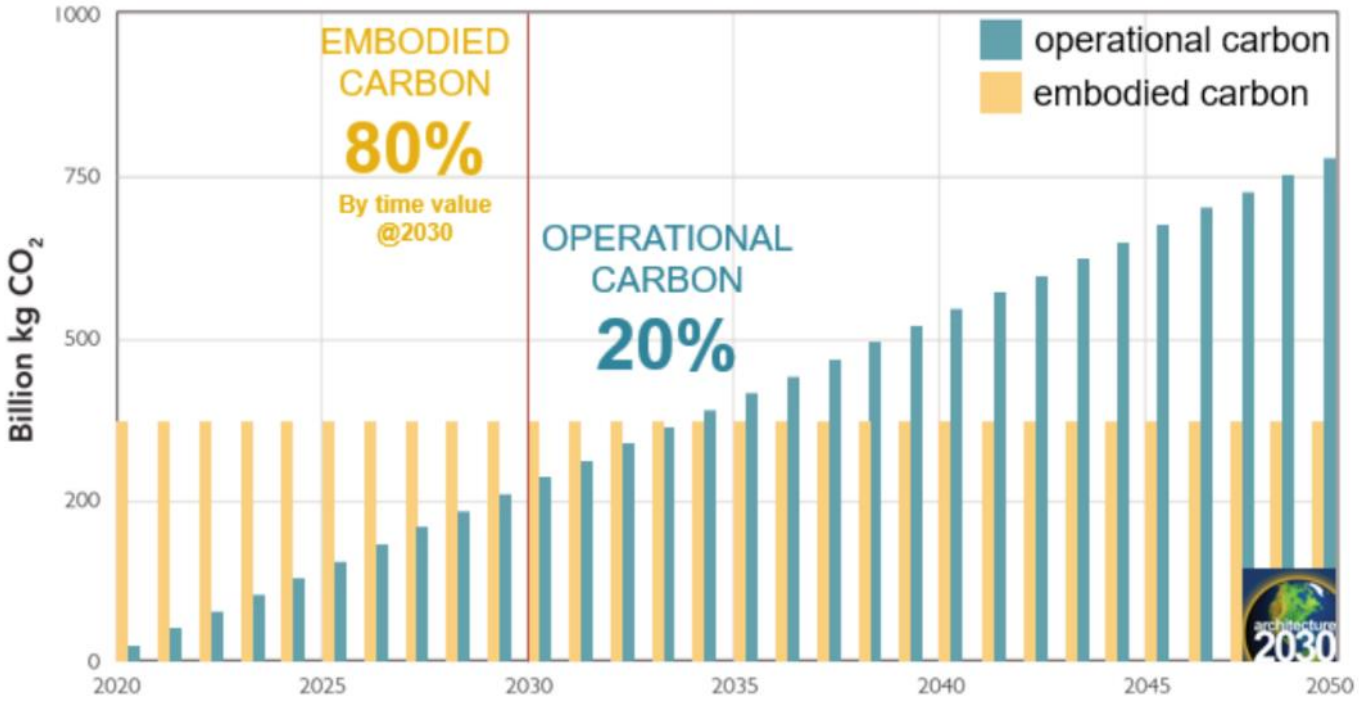
Building Materials and Construction 11%

(New buildings)

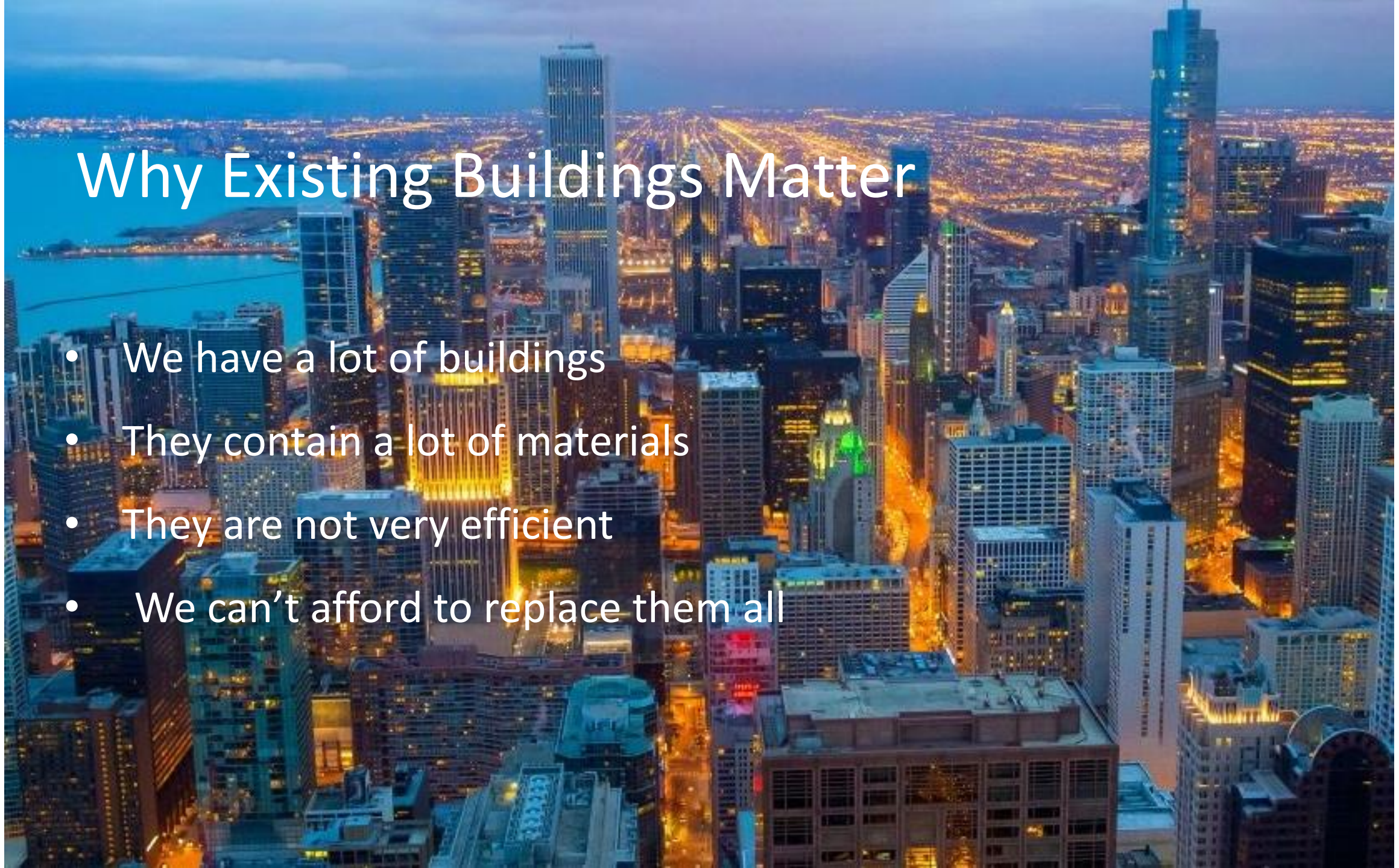
(Existing buildings)

Total building emissions:+/- 40%

Time Value of Carbon



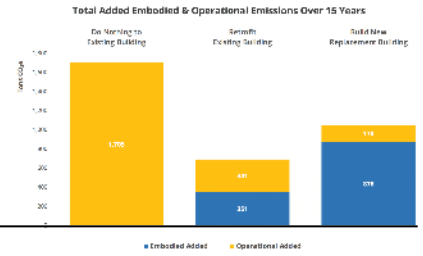
New Buildings built between now and 2050



Why Existing Buildings Matter

- We have a lot of buildings
- They contain a lot of materials
- They are not very efficient
- We can’t afford to replace them all

C.A.R.E – Carbon Avoided Retrofit Estimator



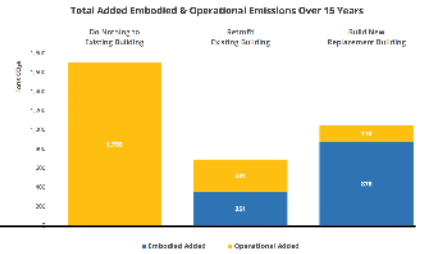
Compares

- Embodied carbon
- Operational carbon
- Avoided carbon

Existing, New & Reuse Scenarios

- Existing Baseline Building
- Replace Existing w/New Building (4 types)
- Reuse & Retrofit Existing – (menu of retrofit options)

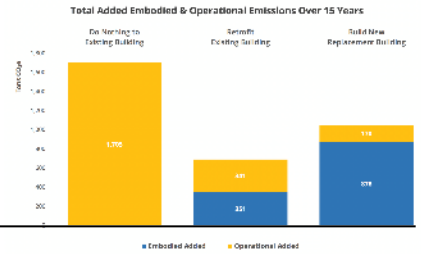
C.A.R.E – Carbon Avoided Retrofit Estimator



Partners

- Architecture 2030
- Carbon Leadership Forum (CLF)
- Zero Net Carbon Collaboration (ZNCC)
- Climate Heritage Network (CHN)
- EHDD and the EPIC Tool

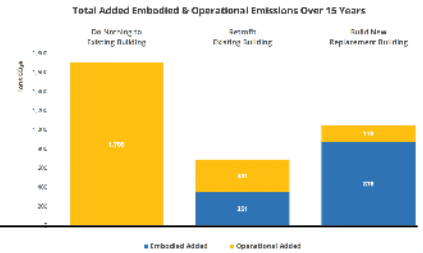
C.A.R.E – Carbon Avoided Retrofit Estimator



Data Sources

- Architecture 2030 Zero Tool
- CLF Embodied Carbon studies
- Athena Embodied Carbon Studies
- Residensity
- SEAOC Embodied Carbon Study
- Whole Building LCA studies – various sources

C.A.R.E – Carbon Avoided Retrofit Estimator



BUILDING SITE & PROJECT USE TYPE

Click in the white cells to select from a dropdown menu or enter information about your building site and planned project use type.

State	Massachusetts
Zip Code	2115
Primary Use Type	Education
Existing Building Floor Area	18,000 sf
Operational Timeline	15 years

key climate dates: 2030 & 2040

ABOUT THE EXISTING BUILDING RETROFIT

Click in the white cells to select from a dropdown menu or enter information about retrofitting the existing building. Embodied emissions and operational energy values associated with each selection will automatically populate to the right.

Retrofit Building Floor Area: 18,000 sf

EMBODIED PERFORMANCE: EFFICIENCY UPGRADES		kg/m2
Mechanical & Electrical	All New	45
Envelope	Major Upgrade w/ Curtain Wall	15
EMBODIED PERFORMANCE: CORE & SHELL RENOVATION		**kg/m2**
Interior	All New: 0% Retained	50
Cladding	Minor - Punched openings: new Winc	25
Structure	Minor: Heavy Structure, concrete / s	50
total embodied emissions / m2		210

OPERATIONAL PERFORMANCE		kBtu/sf-yr
Baseline EUI	*Defaults to CBECS 2003, or enter own EUI*	85
Performance Target	80% Better than Baseline	17
total operational emissions / m2		kg/m2 204

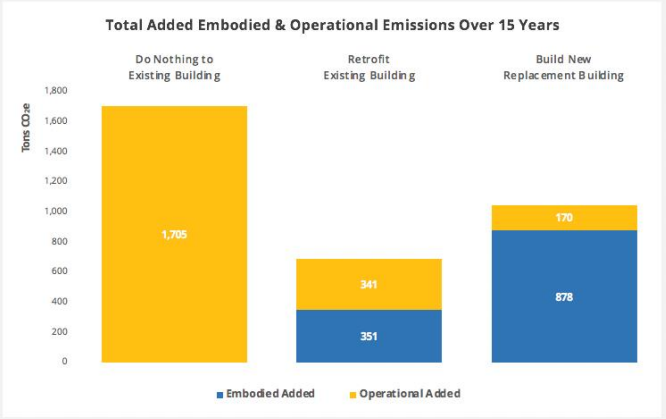
ABOUT THE NEW BUILDING

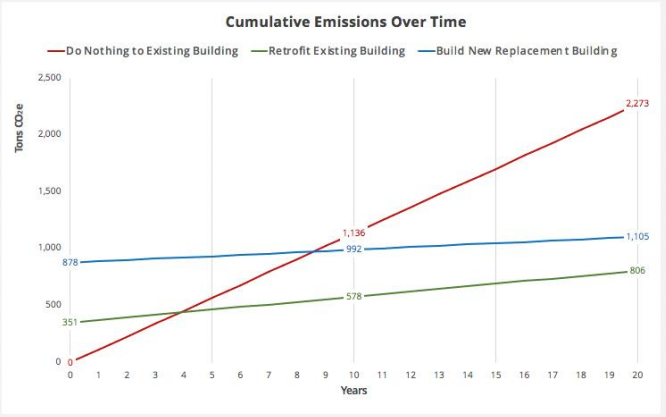
Click in the white cells to select from a dropdown menu or enter information about building a new building. Embodied emissions and operational energy values associated with each selection will automatically populate to the right.

New Building Floor Area: 18,000 sf

EMBODIED PERFORMANCE		kg/m2
Building Type & Structure	Mid Rise	500
total embodied emissions		525

OPERATIONAL PERFORMANCE		kBtu/sf-yr
Baseline EUI	*Defaults to Code Average, or enter own EUI*	43
Performance Target	80% Better than Baseline	9
total operational emissions		kg/m2 102



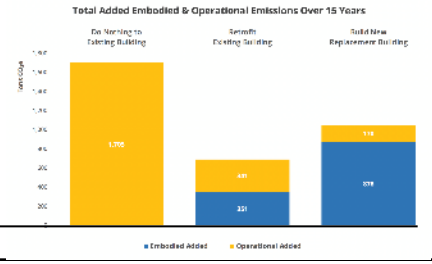


	EMBODIED EMISSIONS (CO2e, cradle to gate)			OPERATIONAL EMISSIONS (CO2e, 15 years)			TOTAL EMISSIONS
	Added kg/m2	Added Tons	Total Tons	EUI (kBtu/sf-yr)	Added Tons	Total Tons	Tons CO2e 15 years
Do Nothing	0	0	0	85	1,705	1,705	1,705
Retrofit Existing	210	351	351	17	341	341	692
Build New Replacement	525	878	878	9	170	170	1,048

User Interface:

- Dashboard with drop down menus
- A menu of renovation and upgrade options
- Four new building options
- Options for operational efficiency
- Embodied carbon modifiers

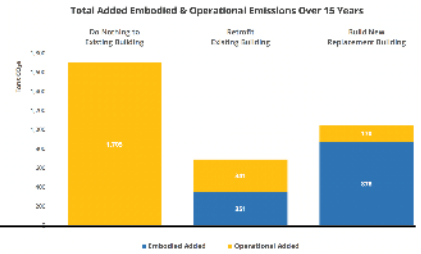
C.A.R.E – Carbon Avoided Retrofit Estimator



Building Retrofit - Embodied Carbon

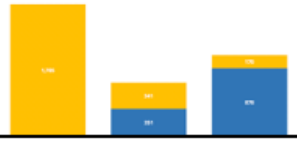
Structure Light / Heavy	**Envelope** Low / High Carbon Materials	**Interiors** Residential / Commercial	**MEP** Standard / High-Performance
No Upgrade	No Upgrade	No Upgrade	No Upgrade
Minor Reinforcing / Repair Major Reinforcing / Repair	Minor: Insulation, Air sealing	Minor: Replace 25%	Minor: New lamping & Controls
Minor Replacement Major Replacement	Medium: New Roof: Medium: New Windows:	Medium: Replace 50%	Medium: New equipment / reuse distribution
Minor Lateral Reinforcing Major Lateral Reinforcing	New Façade: Major	Major: Replace: 100%	Major: New Systems
Calculated as a percentage of new structural system. Choose Light / Heavy structural systems	Calculated as a percentage of new envelope elements, accounts for carbon intensity & wall:floor area ratio	Calculated as a percentage of new interiors accounts for carbon intensity of residential vs commercial	Calculated as a percentage of new HVAC system, accounts for standard or high-performance system

C.A.R.E – Carbon Avoided Retrofit Estimator



New Building - Embodied Carbon			
Light - Wood Framed Building	Mixed – Wood + Concrete / Steel	Mid-Rise Concrete /Steel	High Carbon Buildings
250 kg/m^2	350 kg/m^2	500 kg/m^2	650 kg/m^2

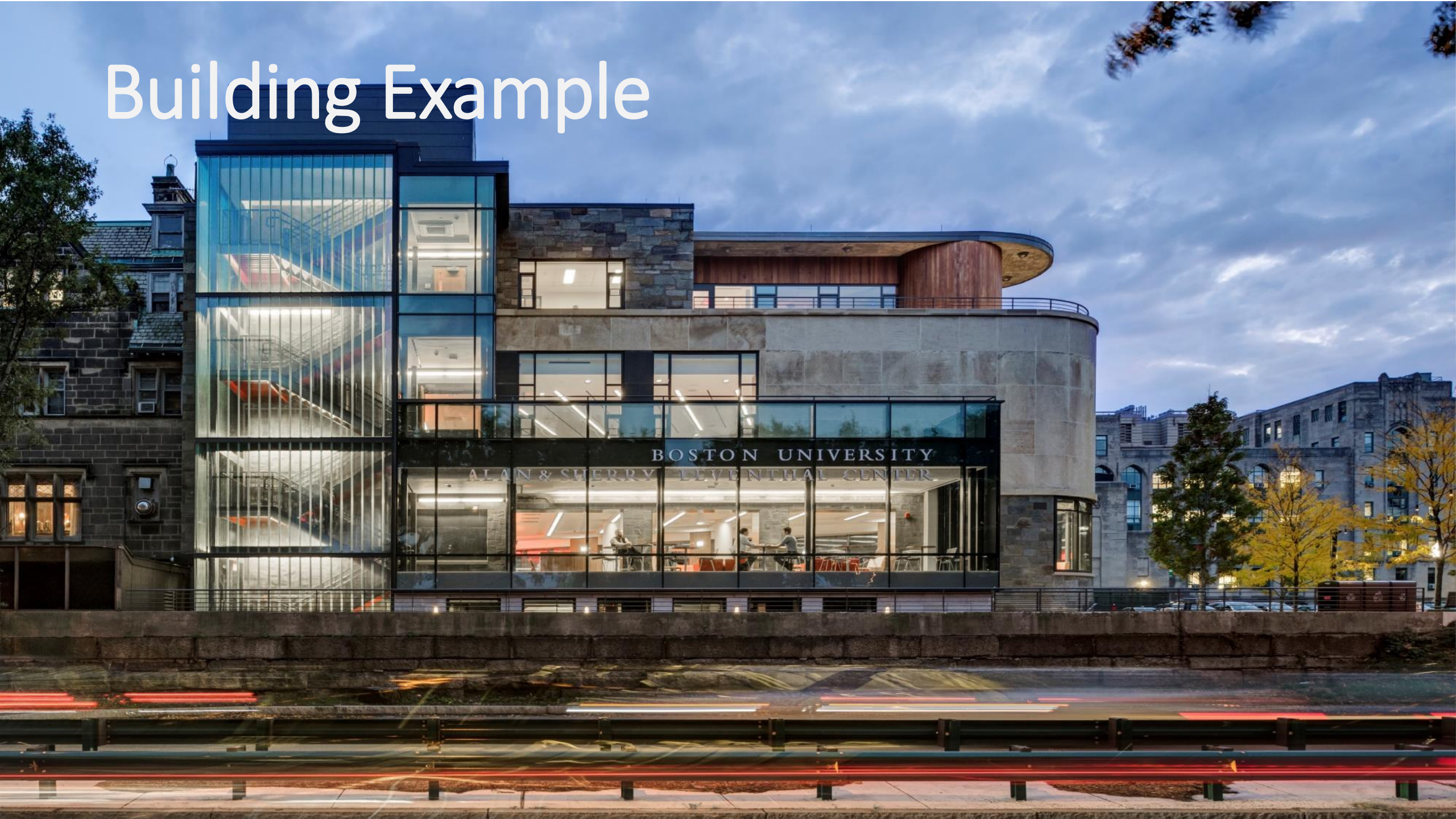
C . A . R . E .

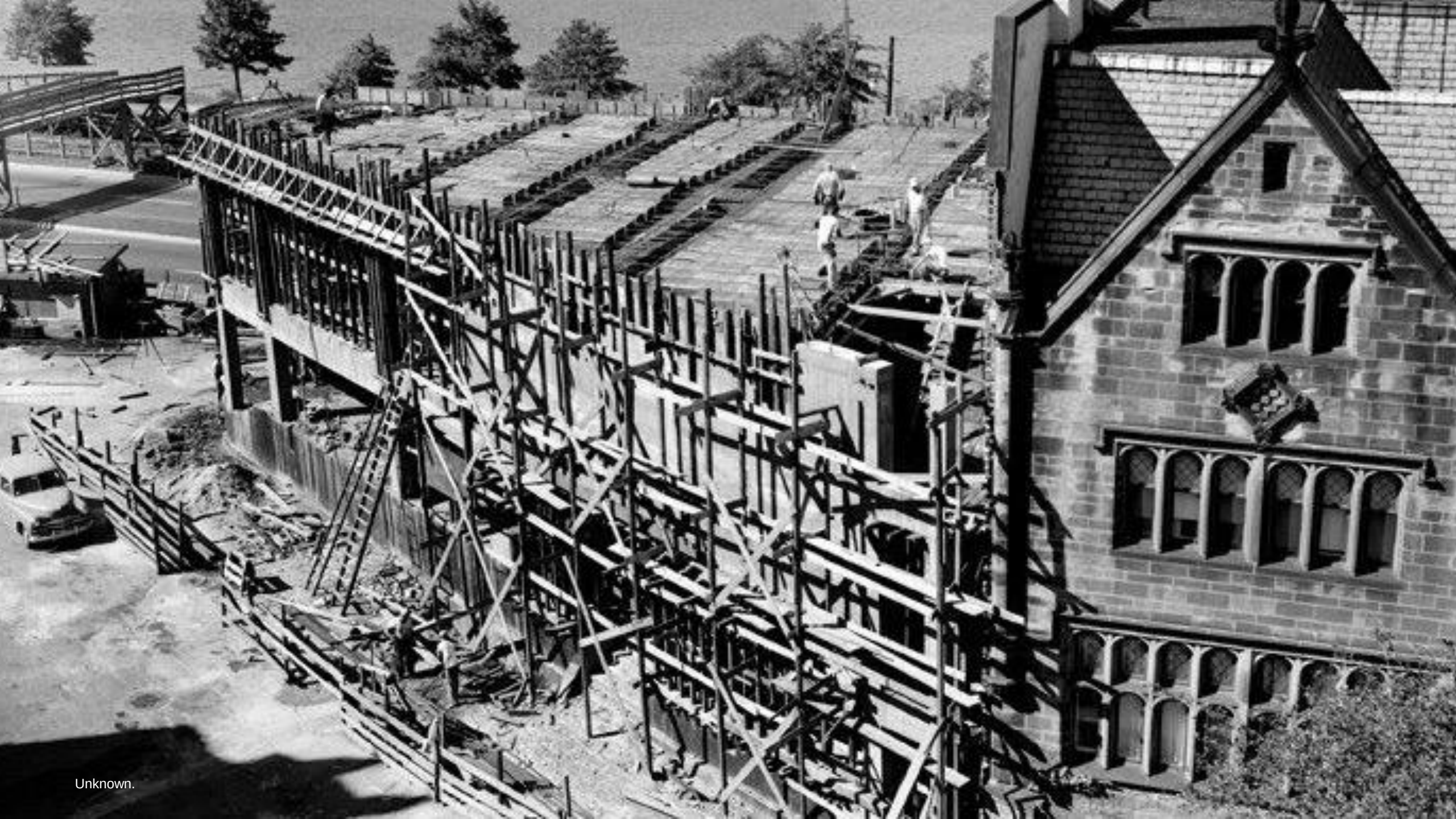


Carbon Avoided : Retrofit Estimator

Operational Carbon		
Existing Building Estimate	**Retrofit Building Target**	**New Building Target**
Baseline – Zero tool	Baseline - no efficiency upgrade	Baseline: Code Average
Or enter your own	20% better than baseline	20% better than baseline
	40% better than baseline	40% better than baseline
	60% better than baseline	60% better than baseline
	80% better than baseline	80% better than baseline
	Net Zero Carbon	Net Zero Carbon

Building Example





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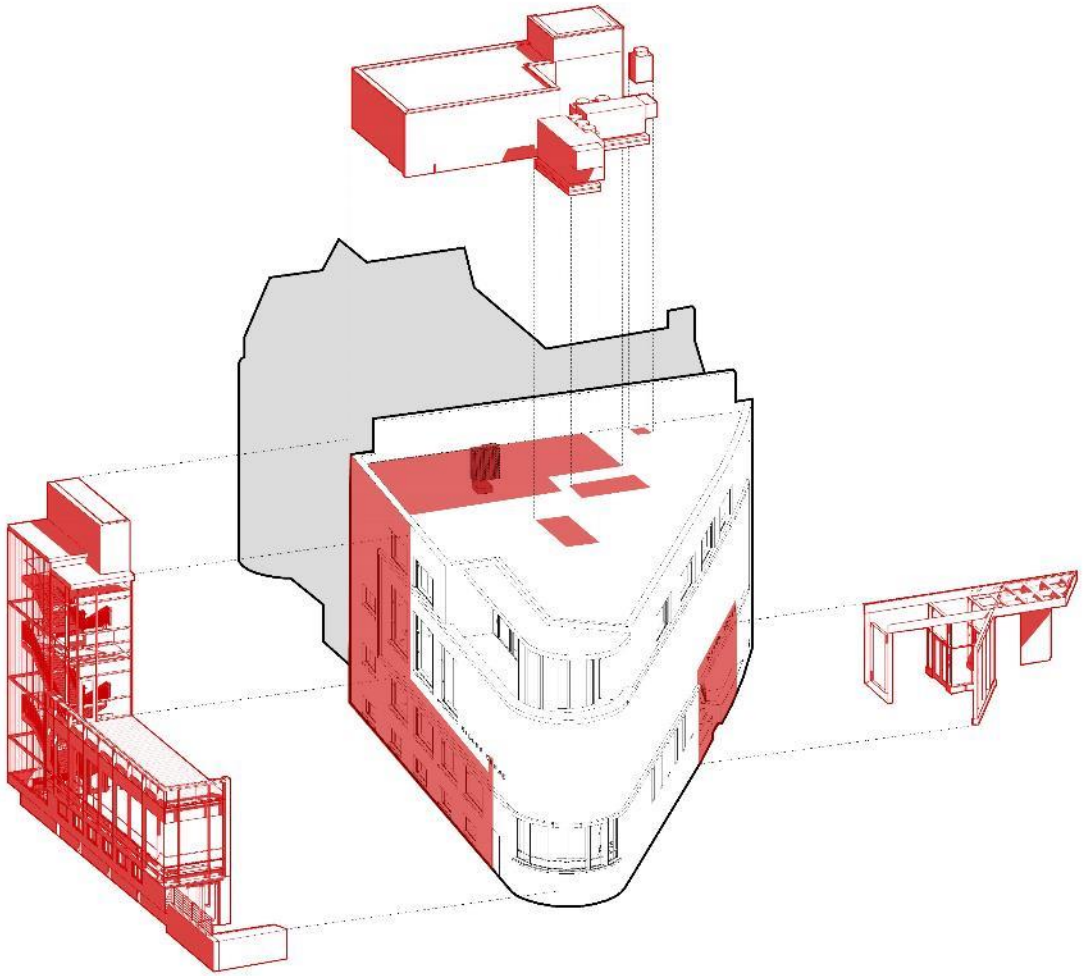

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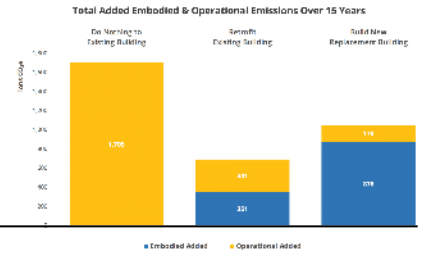
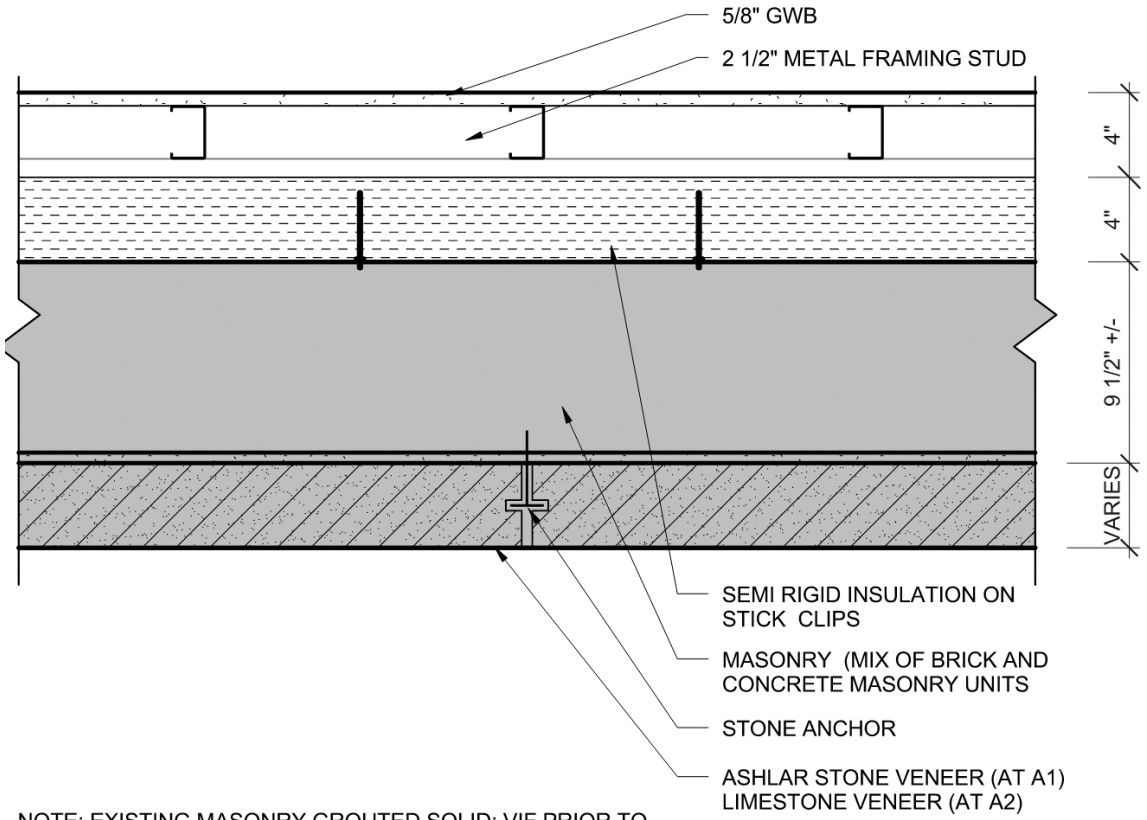


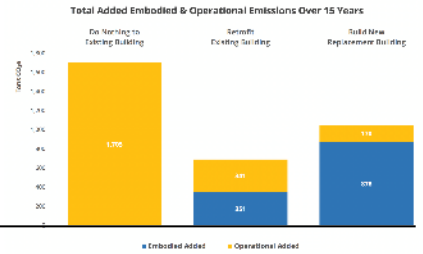
- Scope of renovation included:
  - New windows with high-performance glazing
  - Insulating interior face of exterior walls
  - Roof insulation
  - New VRF units and high-efficiency condensing boilers
- Preserved 86% of structure and enclosure
- Reduced operational energy use by 70%



NOTE: EXISTING MASONRY GROUTED SOLID; VIF PRIOR TO UNDERTAKING REPAIRS. COORDINATE WITH PARTITION TYPE 91

WALL TYPE A1 & A2 - PARTITION TYPE 91 ON EXISTING MASONRY WALL

C.A.R.E – Carbon Avoided Retrofit Estimator



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Zip Code	2115
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Operational Timeline	15 years

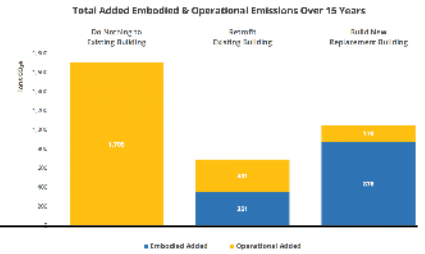
key climate dates: 2030 & 2040

CBECS Climate Zone Mapping

CBECS Use Type

Total Carbon Emissions

C.A.R.E – Carbon Avoided Retrofit Estimator



RETROFIT

Primary Building Use	Office	20,000 ft2
	Retail	5,000 ft2
Add another use type?		

OPERATIONAL ENERGY & EMISSIONS

	Upgrading to all electric systems and equipment?	Yes
	Generating/procuring enough renewable energy to meet total energy demand?	No
Calculate Energy & Emissions Baselines	Baseline EUI	73 kBtu/sf-yr
	Baseline Emissions Intensity	74 kg/m2-yr
EUI Target	40% Better than Baseline	44 kBtu/sf-yr
Emissions Target	80% Better than Baseline	15 kg/m2-yr

EMBODIED EMISSIONS

Structural Upgrade	Heavy ● Light ○	i	Minor: 25% new	50 kg/m2
Envelope Upgrade	High EC ● Low EC ○	i	Medium: New Roof - underlayment, rigid insulation, membrane	20 kg/m2
Interior Upgrade		i	Minor: 25% New	10 kg/m2
MEP Upgrade	Standard ● High Perf. ○	i	Major - new HVAC and electric system	50 kg/m2
			total embodied emissions intensity i	130 kg/m2

Size of Renovated Building for Total Emissions

Operational Energy and Emissions

Embodied Carbon of Renovation
Select from drop down menus

Drop down menu

- No Upgrade
- Minor: Finishes Only
- Minor: 75% Retained
- Major: 50% Retained
- All New: 0% Retained

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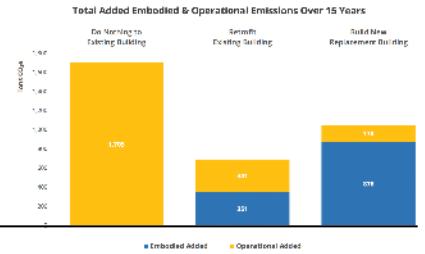

NEW BUILDING

Primary Building Use	Office	20,000 ft2
	Retail	5,000 ft2
Add another use type?		

OPERATIONAL ENERGY & EMISSIONS

Upgrading to all electric systems and equipment?		Yes
Generating/procuring enough renewable energy to meet total energy demand?		No
Calculate Energy & Emissions Baselines	Baseline EUI	66 kBtu/sf-yr
	Baseline Emissions Intensity	67 kg/m2-yr
EUI Target	60% Better than Baseline	26 kBtu/sf-yr
Emissions Target	Zero Carbon	0 kg/m2-yr

EMBODIED EMISSIONS

Building Type & Structure i	Mixed	325 kg/m2
total embodied emissions intensity i		325 kg/m2

Size of New Building for Total Emissions

Operational EUI of New Building

Operational Emissions

Embodied Carbon of New Building

Select from drop down menus

Drop down menu

- Light
- Mixed
- Mid Rise
- High Carbon

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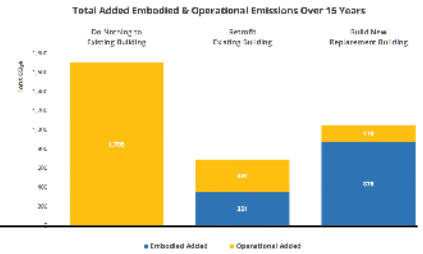
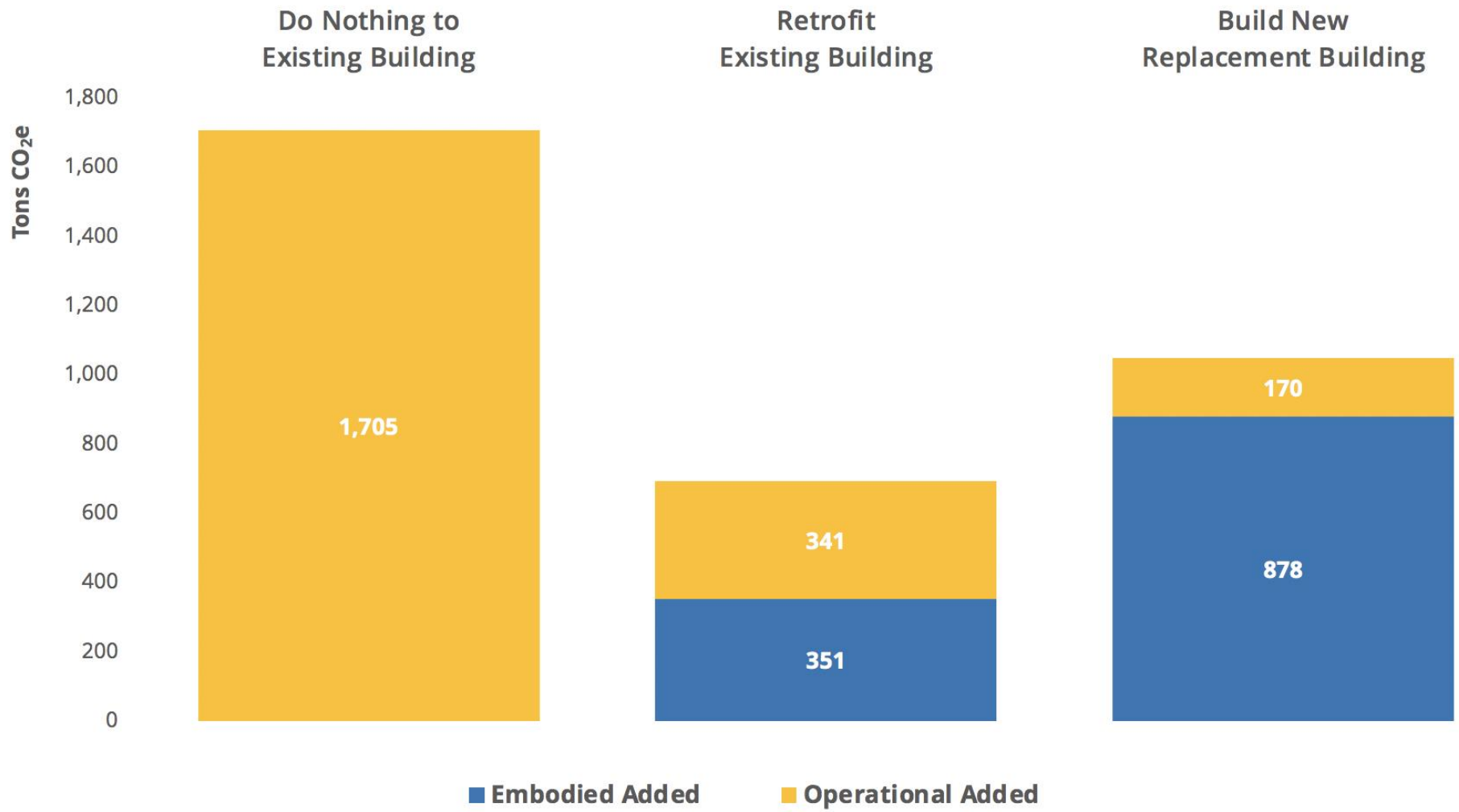


Total Added Embodied & Operational Emissions Over 15 Years



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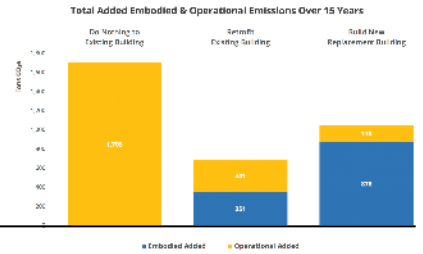
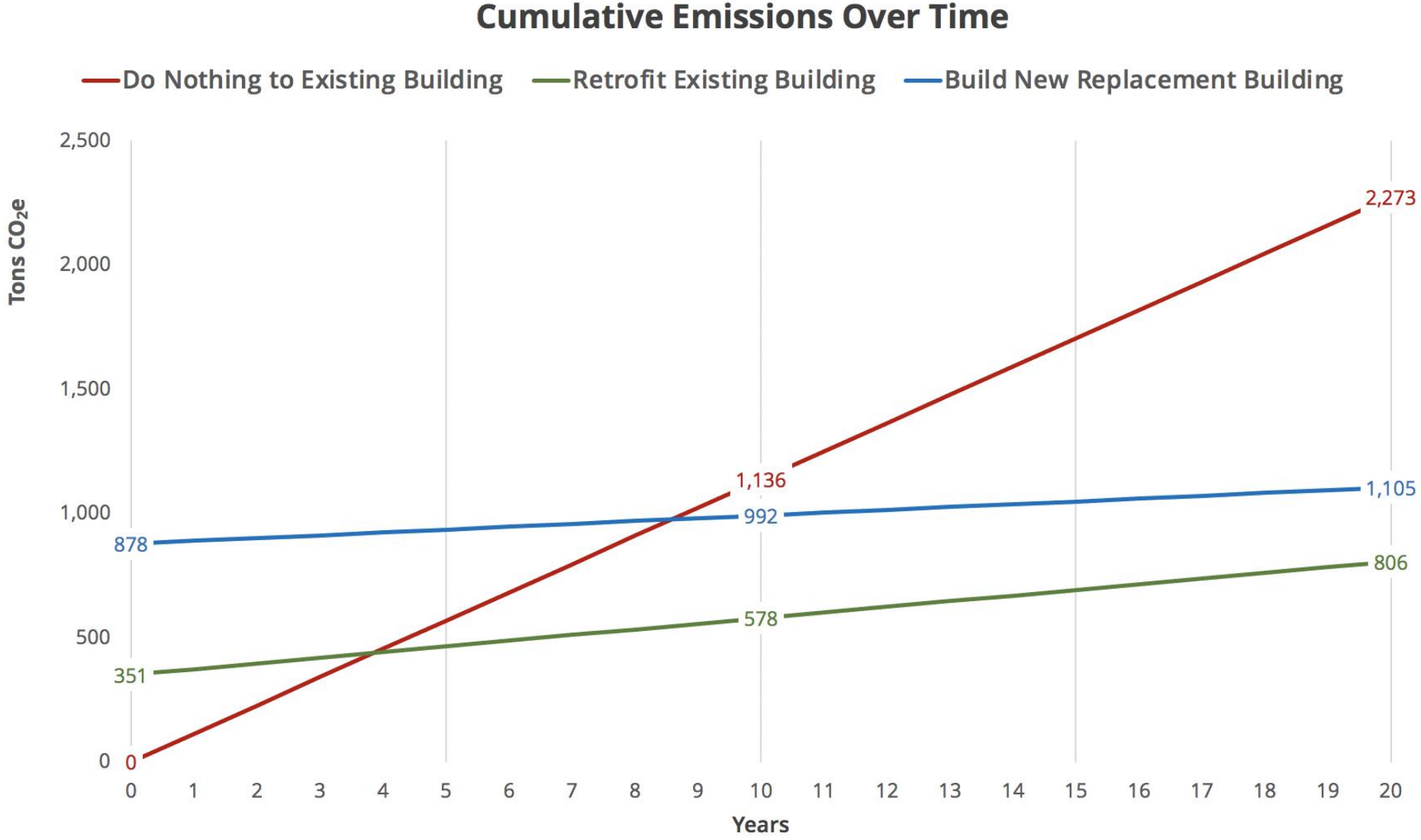


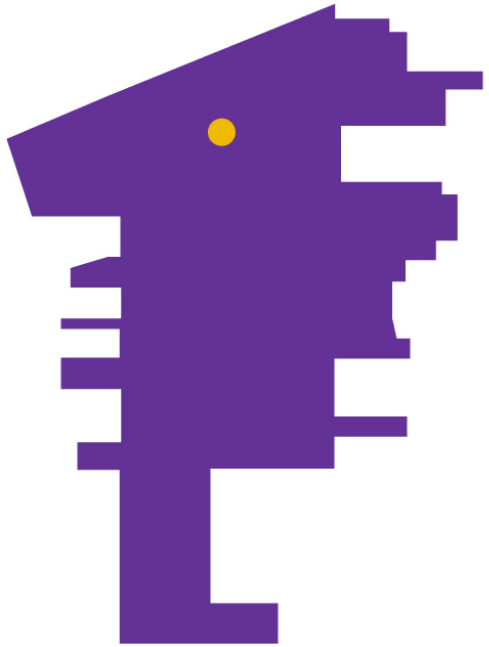
Cumulative Emissions Over Time



Portfolio Example

Historic Campus Growth

Photo credit: Agnes Scott Special Collections



1891

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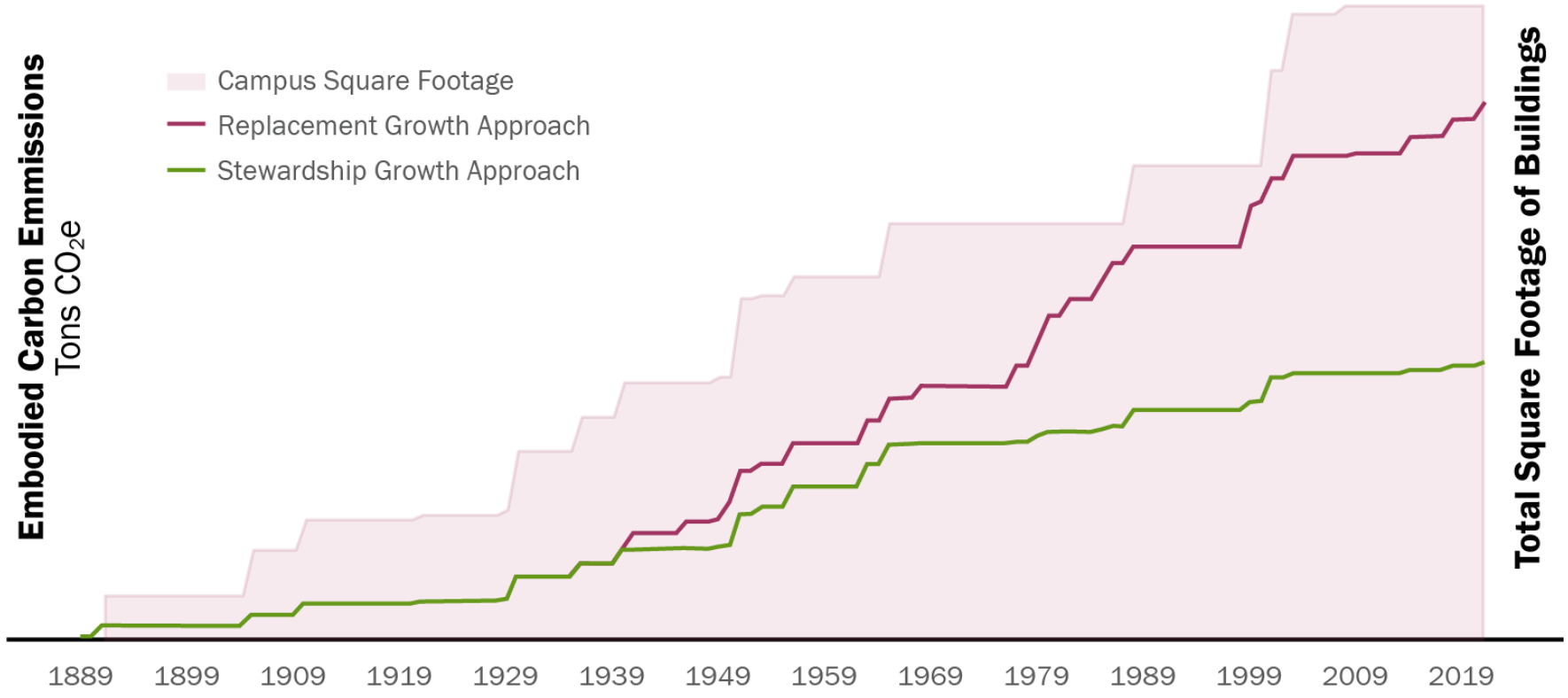
Approach to Growth 1889 - 2021

Over its history, the college's stewardship approach to growth has **avoided embodied emissions equivalent to 34,000 metric tons of CO2e**.

It would take a **forest the size of the entire Agnes Scott campus more than 400 years** to sequester that much CO2.



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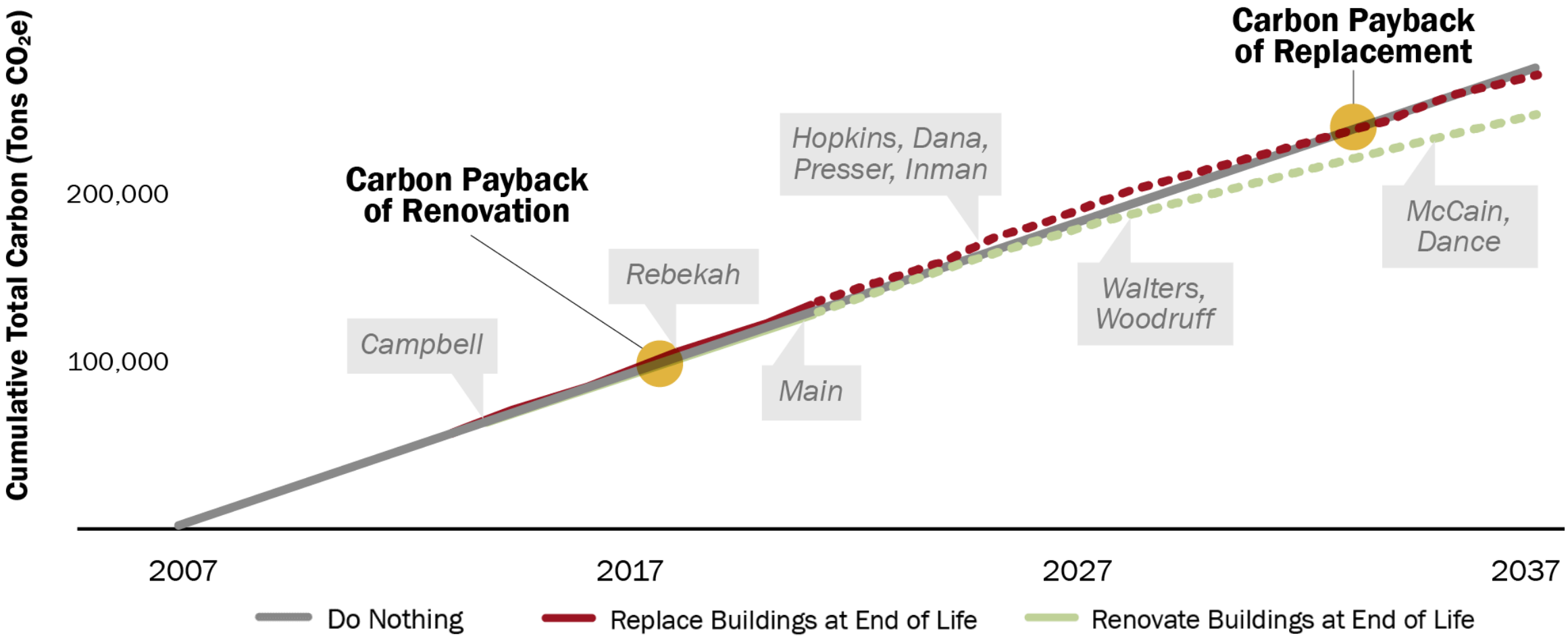
Campus Scale Cumulative Emissions



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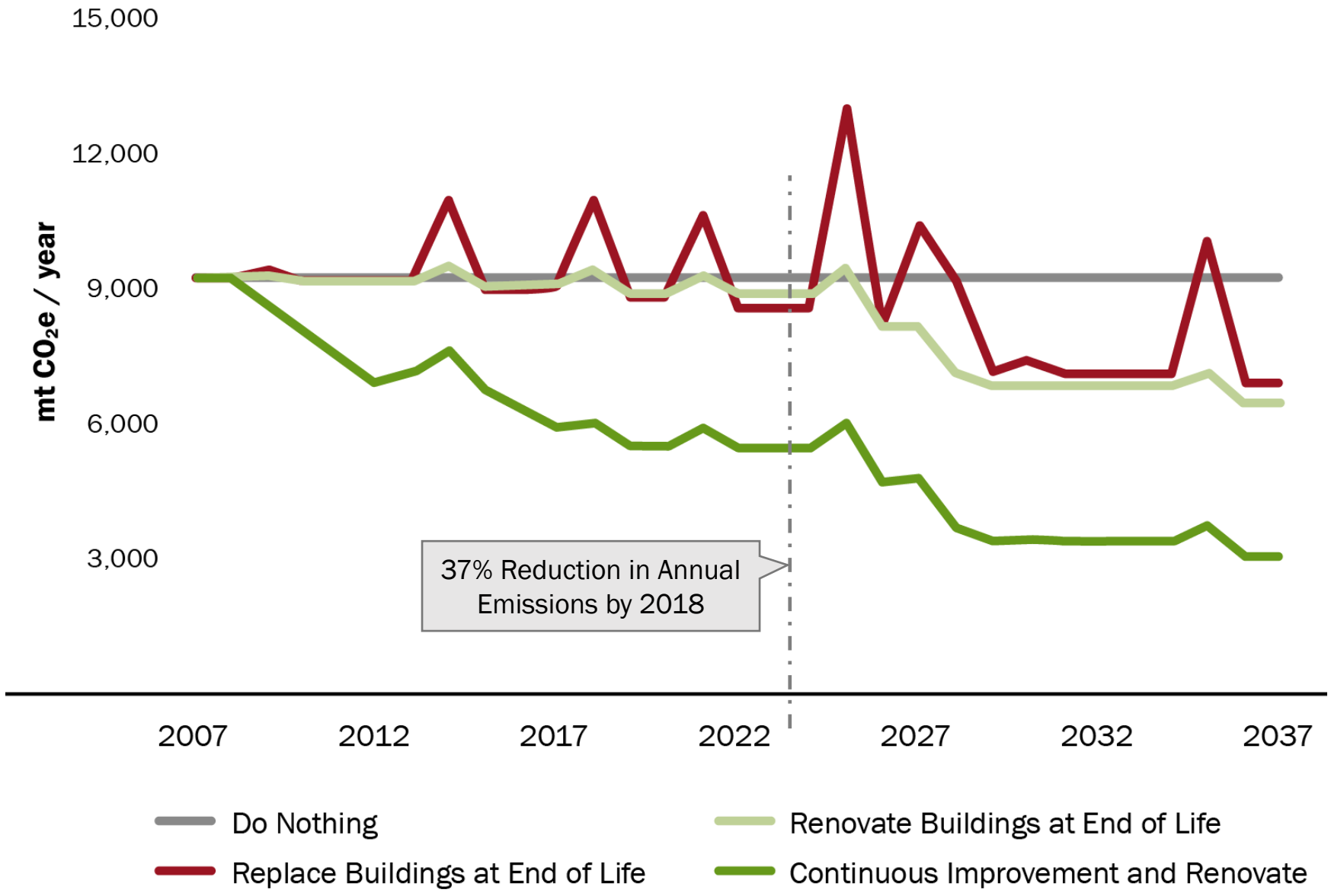
Campus Scale Annual Carbon Emissions 2007-2037



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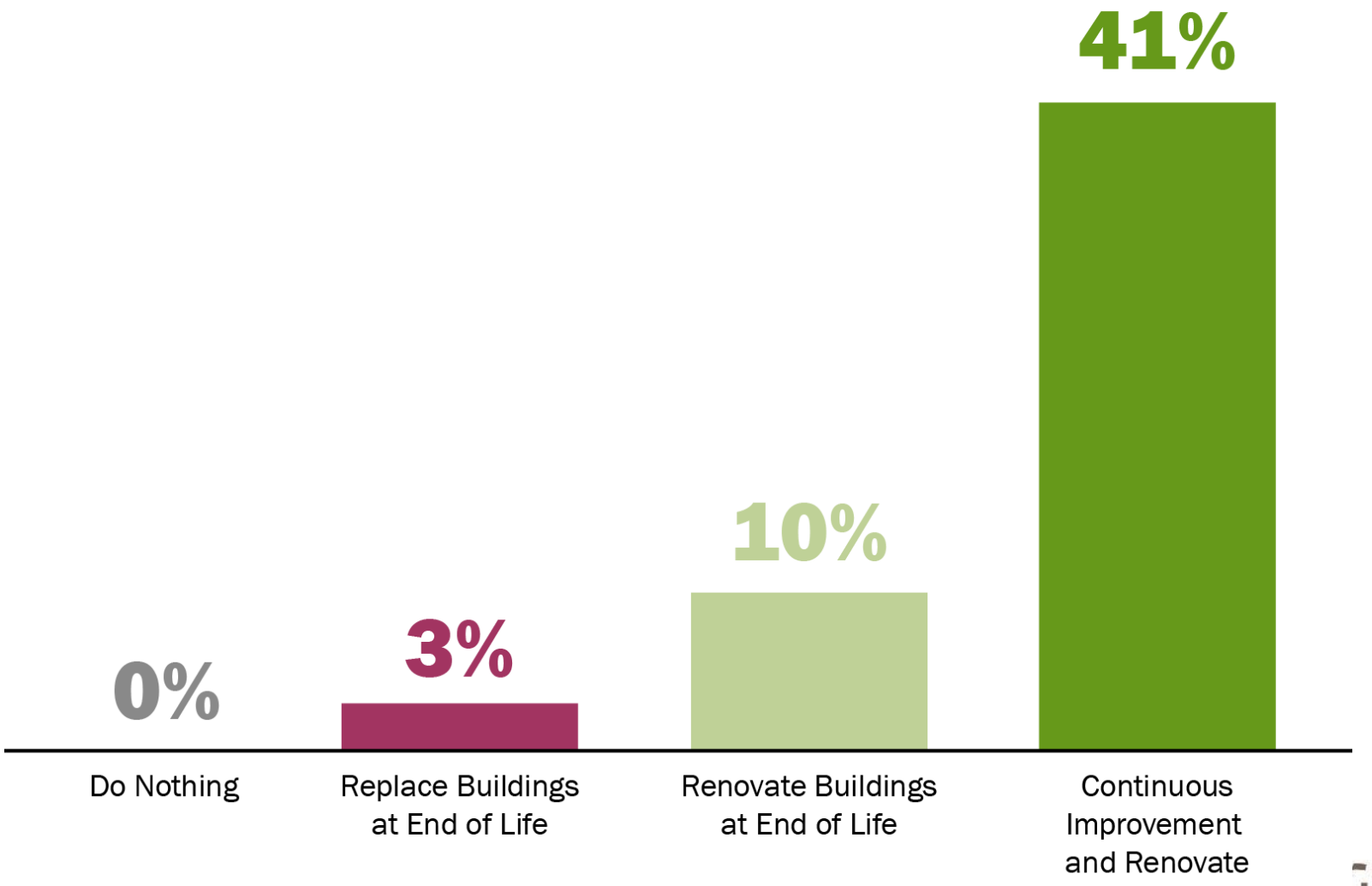
Total Reduction in Carbon Emissions 2007-2037



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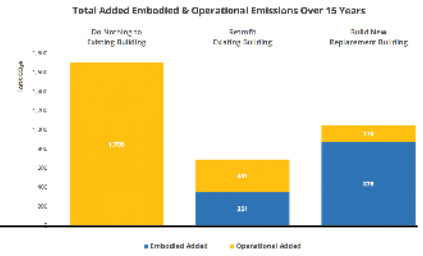
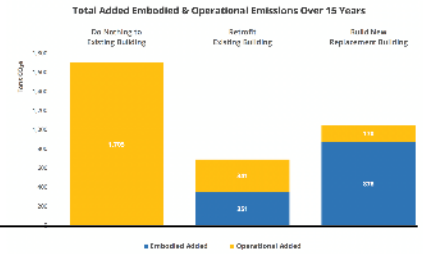


Potential Future Development

- Independent renovation and addition inputs
- Saved scenarios for comparison
- Manual emissions factors and fuel source options
- Expanded drop-down options
- Geographic expansion
- Portfolio function

C.A.R.E – Carbon Avoided Retrofit Estimator



Thank you

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Learn More

Preservation Priorities Task Force: PreservationPriorities.org

PPTF Climate Justice webinar: Early May

Forum webinar series: https://forum.savingplaces.org/forum-webinar

C.A.R.E. Tool Updates: https://www.znccollaboration.org/care

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More about the PPTF:

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