

URBAN GREEN LIVE

Office to Residential Conversions: The Carbon Story

URBAN
GREEN



Thank you to our sponsor

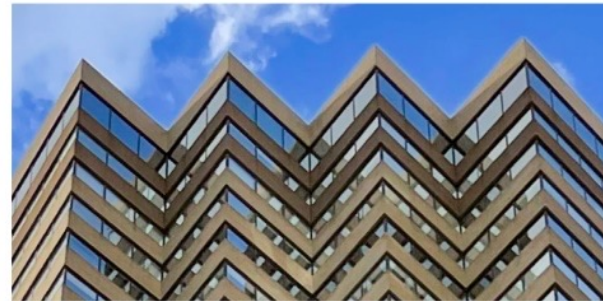
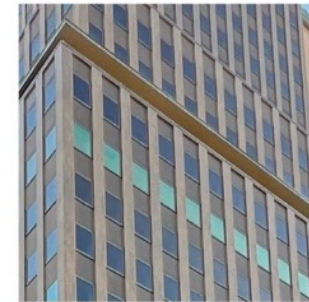
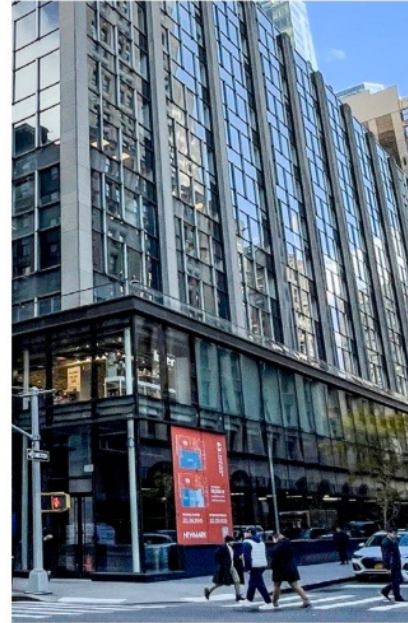


Office to Residential Conversions: The Carbon Story



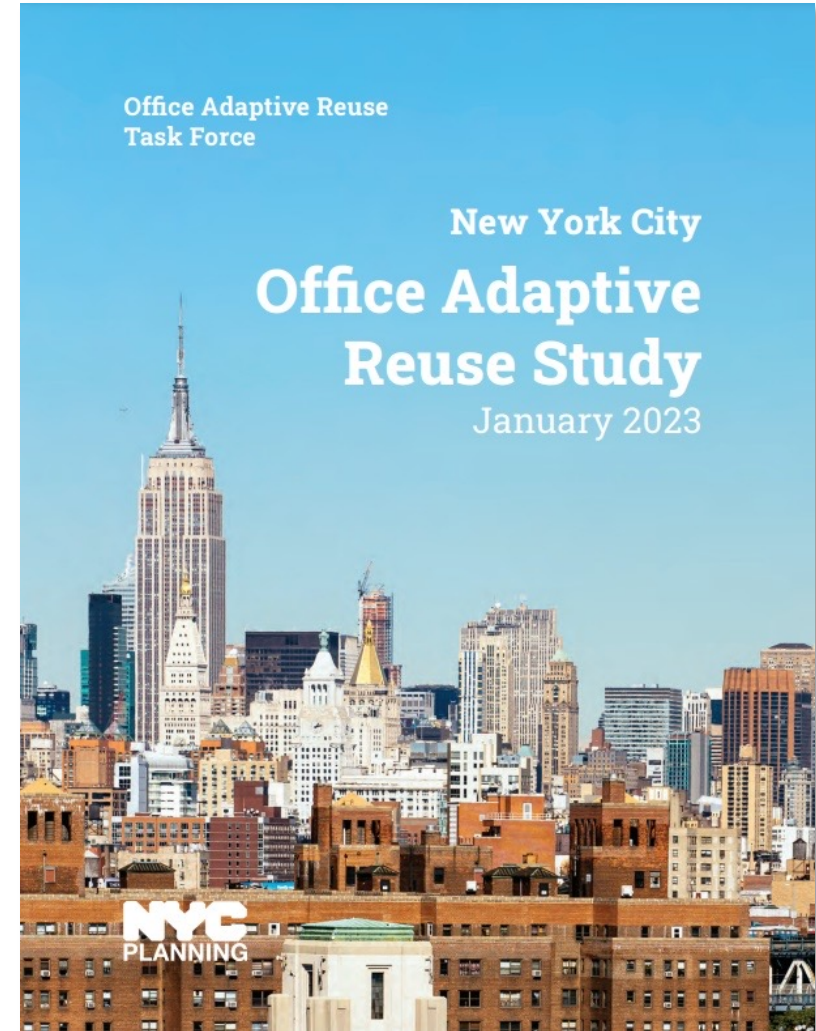
Research Aim

This research set out to answer a simple question: how much carbon could be saved by 2050 if New York City **expanded the range of buildings eligible for office to residential conversions?**



NYC Office Adaptive Reuse Study

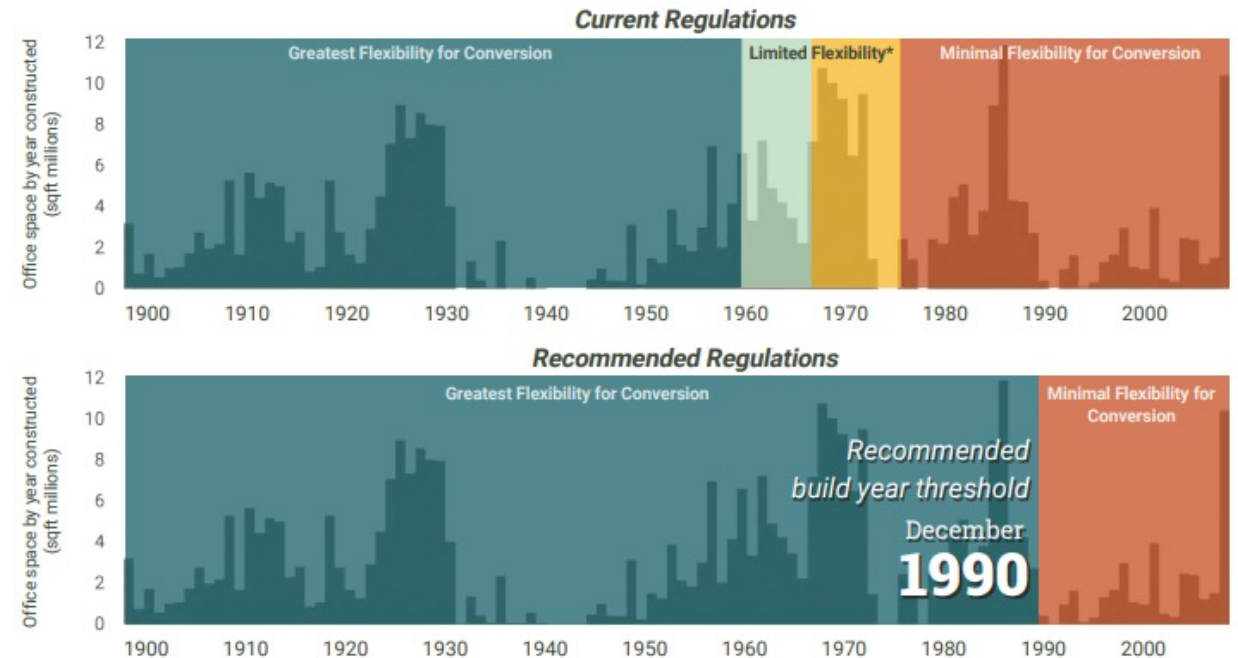
- January 2023 Office Adaptive Reuse Study proposes relaxing zoning regulations to allow more conversions
- This study projects that the expanded flexibility for office conversions could **create 20,000 homes in the next decade**, enough to house up to 40,000 New Yorkers



City of Yes: Housing Opportunity

- Current zoning prohibits conversion of office buildings constructed after 1960 (with some exceptions in the Financial District)
- Proposed zoning would expand conversion flexibility to **all buildings built before December 1990**

Figure 6: Comparison of Office-to-Residential Existing and Proposed Conversion Regulations by Year of Construction



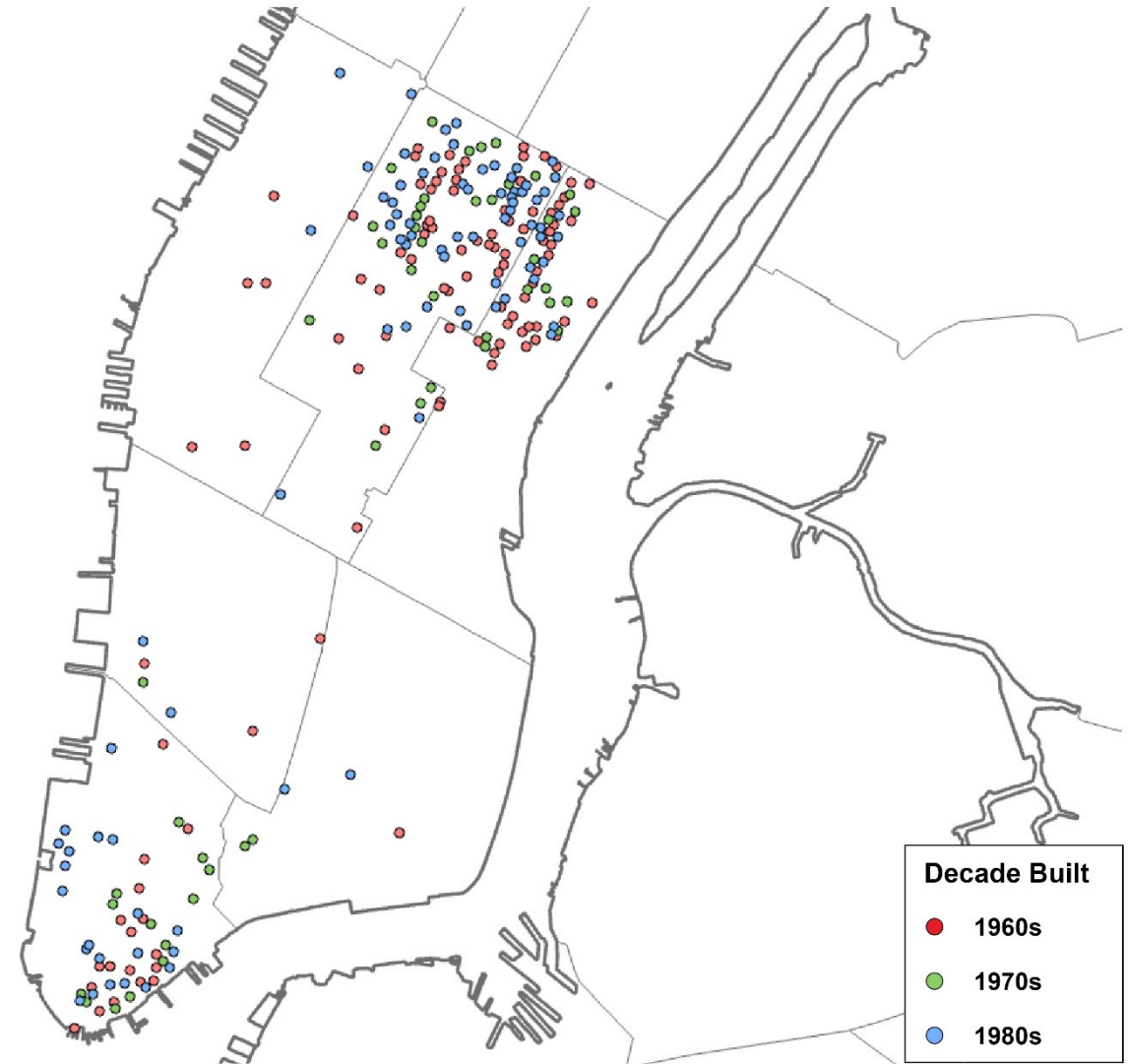
* Most flexible conversion regulations are only accessible to an office building located in FiDi. Additionally office buildings permitted after 1969 can typically only transfer 12 FAR of office space to residential uses.

Note: Chart only includes office area located in the Article 1 Chapter 5 geography in locations where residential is allowed as-of-right. Only include buildings in the following building classes: O2 thru O9 and RB/RC.

Source: New York City Department of City Planning

Analyzed Buildings

- This study focuses on the office buildings that are the subject of potential zoning changes identified by the Task Force
- This includes office buildings built in the 1960s, 1970s, and 1980s, below 59th street in Manhattan
- **The resulting 222 buildings were analyzed in this study**

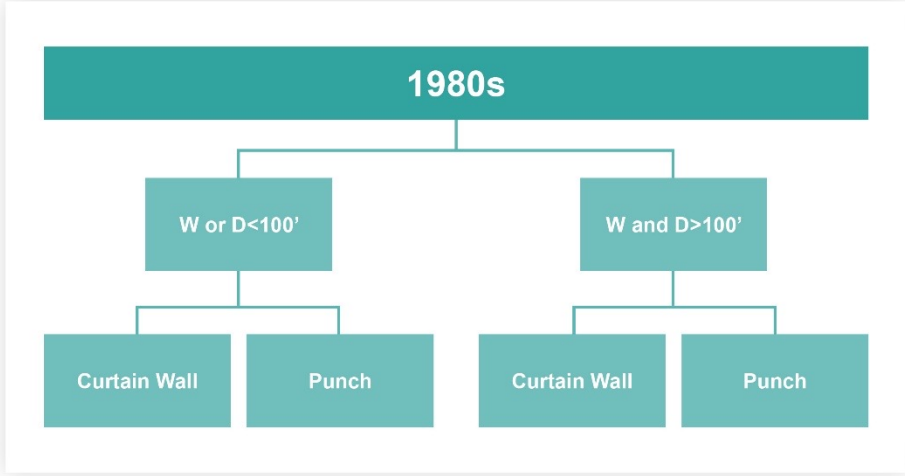
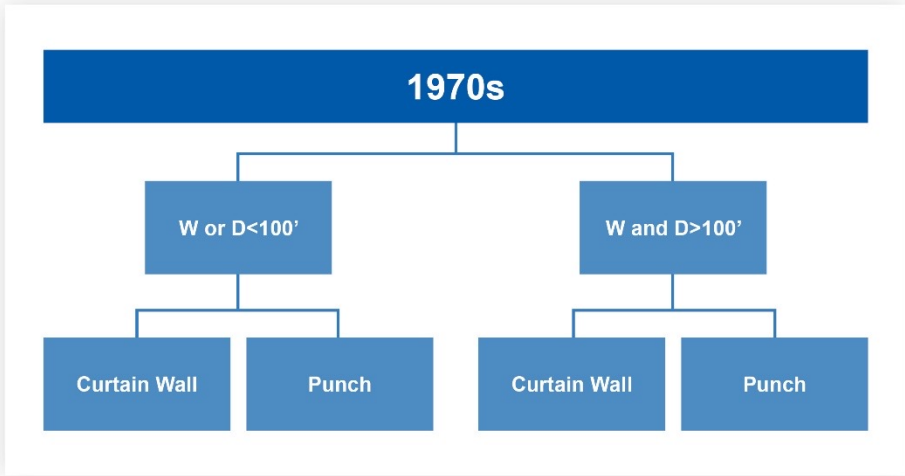
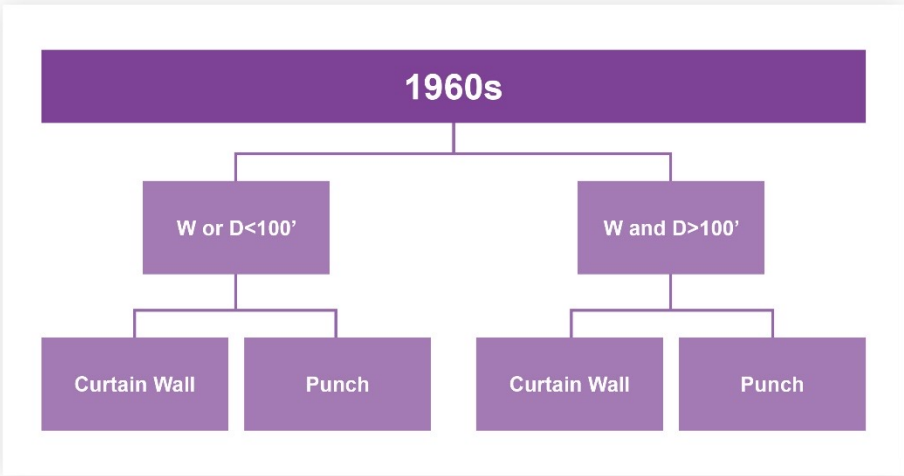


Embodied and Operational Carbon

- **Embodied Carbon:**
Emissions associated with the materials and construction processes throughout the whole life cycle of a building, from material extraction to demolition and disposal
- **Operational Carbon:**
Emissions associated with the energy used to operate the building



Typological Approach



12 Typologies | 1960s



Wide Curtain Wall

Location:	63 Madison Avenue
Built:	1962
EUI:	73.5 kBtu/sq. ft.
Avg floor size:	46,853 sq. ft.
Vacancy rate:	26.6%



Wide Punch

Location:	222 Broadway
Built:	1961
EUI:	73.4 kBtu/sq. ft.
Avg floor size:	24,392 sq. ft.
Vacancy rate:	63.1%



Narrow Curtain Wall

Location:	111 East 58 th Street
Built:	1969
EUI:	78.4 kBtu/sq. ft.
Avg floor size:	16,576 sq. ft.
Vacancy rate:	N/A



Narrow Punch

Location:	1180 Avenue of the Americas
Built:	1963
EUI:	60.5 kBtu/sq. ft.
Avg floor size:	14,898 sq. ft.
Vacancy rate:	64.7%

12 Typologies | 1970s



Wide Curtain Wall

Location:	888 7 th Avenue
Built:	1970
EUI:	87.7 kBtu/sq. ft.
Avg floor size:	19,252 sq. ft.
Vacancy rate:	8.2%



Wide Punch

Location:	24 State Street
Built:	1971
EUI:	86.7 kBtu/sq. ft.
Avg floor size:	25,627 sq. ft.
Vacancy rate:	N/A



Narrow Curtain Wall

Location:	800 3 rd Avenue
Built:	1970
EUI:	108.2 kBtu/sq. ft.
Avg floor size:	12,832 sq. ft.
Vacancy rate:	19.9%



Narrow Punch

Location:	88 Pine Street
Built:	1973
EUI:	87.2 kBtu/sq. ft.
Avg floor size:	20,781 sq. ft.
Vacancy rate:	27.3%

12 Typologies | 1980s



Wide Curtain Wall

Location:	875 3 rd Avenue
Built:	1982
EUI:	58.5 kBtu/sq. ft.
Avg floor size:	21,868 sq. ft.
Vacancy rate:	6.0%



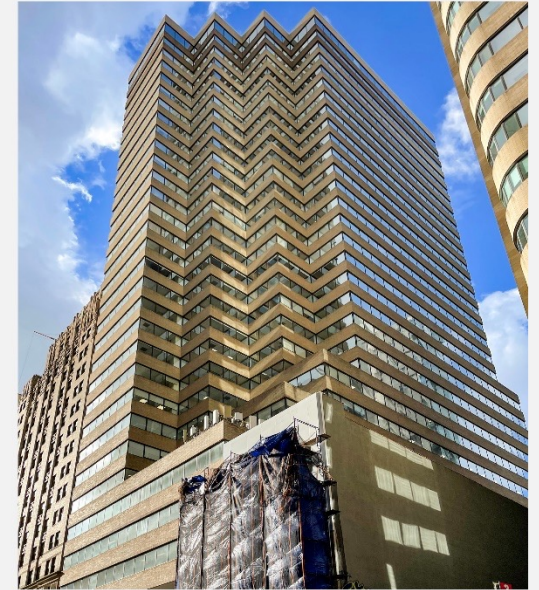
Wide Punch

Location:	512 Madison Ave
Built:	1982
EUI:	77.4 kBtu/sq. ft.
Avg floor size:	23,611 sq. ft.
Vacancy rate:	N/A



Narrow Curtain Wall

Location:	135 East 57 th Street
Built:	1987
EUI:	63.4 kBtu/sq. ft.
Avg floor size:	12,417 sq. ft.
Vacancy rate:	63.2%



Narrow Punch

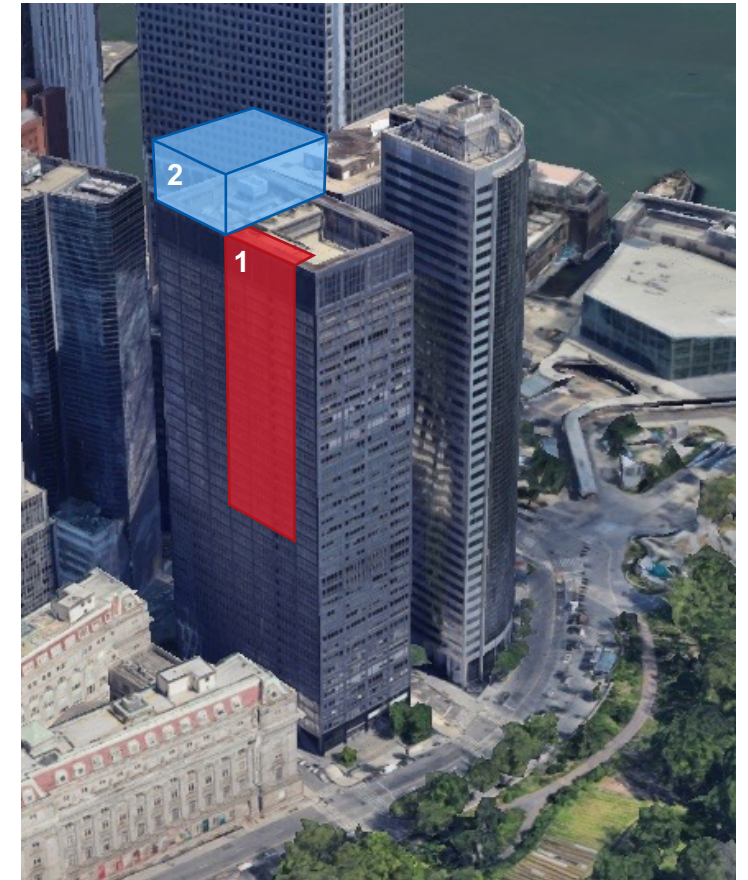
Location:	45 Broadway
Built:	1983
EUI:	55.7 kBtu/sq. ft.
Avg floor size:	11,881 sq. ft.
Vacancy rate:	19.1%

Embodied Carbon

Wide

1. Calculate embodied carbon from **demolition and disposal of structure** from ‘carving’
2. Calculate upfront embodied carbon from **production + construction of the structure of additional FAR built on top**

Example: 24 State Street (Wide, Punch, 1970s)



*This study evaluated embodied carbon of structure & enclosure only, due to limited sources of robust embodied carbon data for MEP systems and interiors

Embodied Carbon

Punch

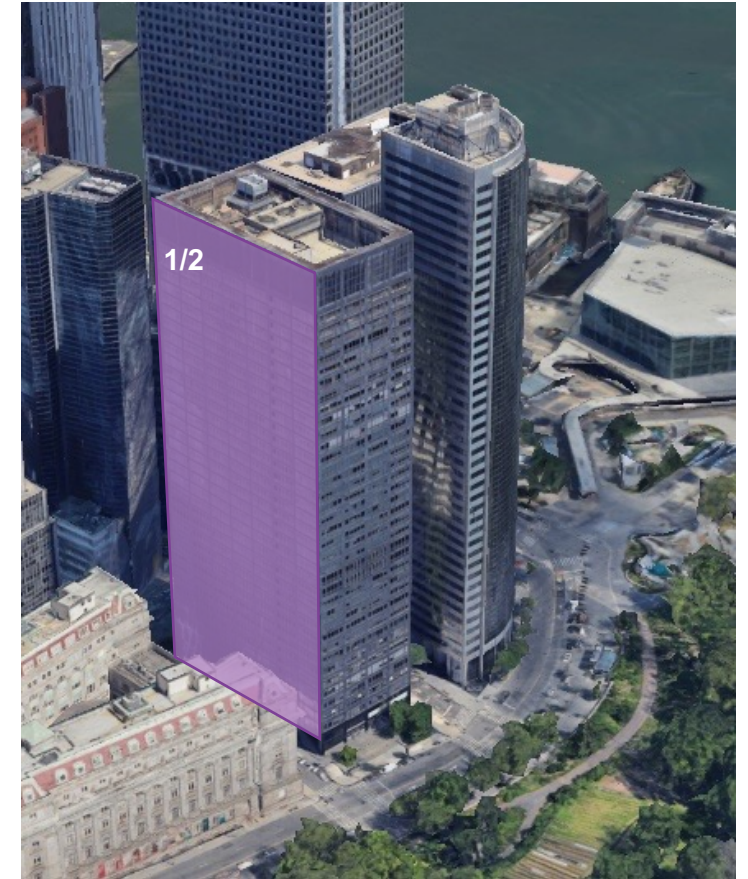
1. Calculate embodied carbon from **demolition and disposal of windows**
2. Calculate upfront embodied carbon from **production + construction of new windows**

OR

Curtain Wall

1. Calculate embodied carbon from **demolition and disposal of curtain wall**
2. Calculate upfront embodied carbon from **production + construction of new curtain wall**

Example: 24 State Street (Wide, Punch, 1970s)



*This study evaluated embodied carbon of structure & enclosure only, due to limited sources of robust embodied carbon data for MEP systems and interiors

Operational Carbon

Punch

-1.3%

Lighting reduction

-7.4%

HVAC and DHW electrification ★

-3.8%

Window replacement

Curtain Wall

-1.3%

Lighting reduction

-7.4%

HVAC and DHW electrification ★

-3.8%

Window replacement

-5.0%

Increase wall insulation

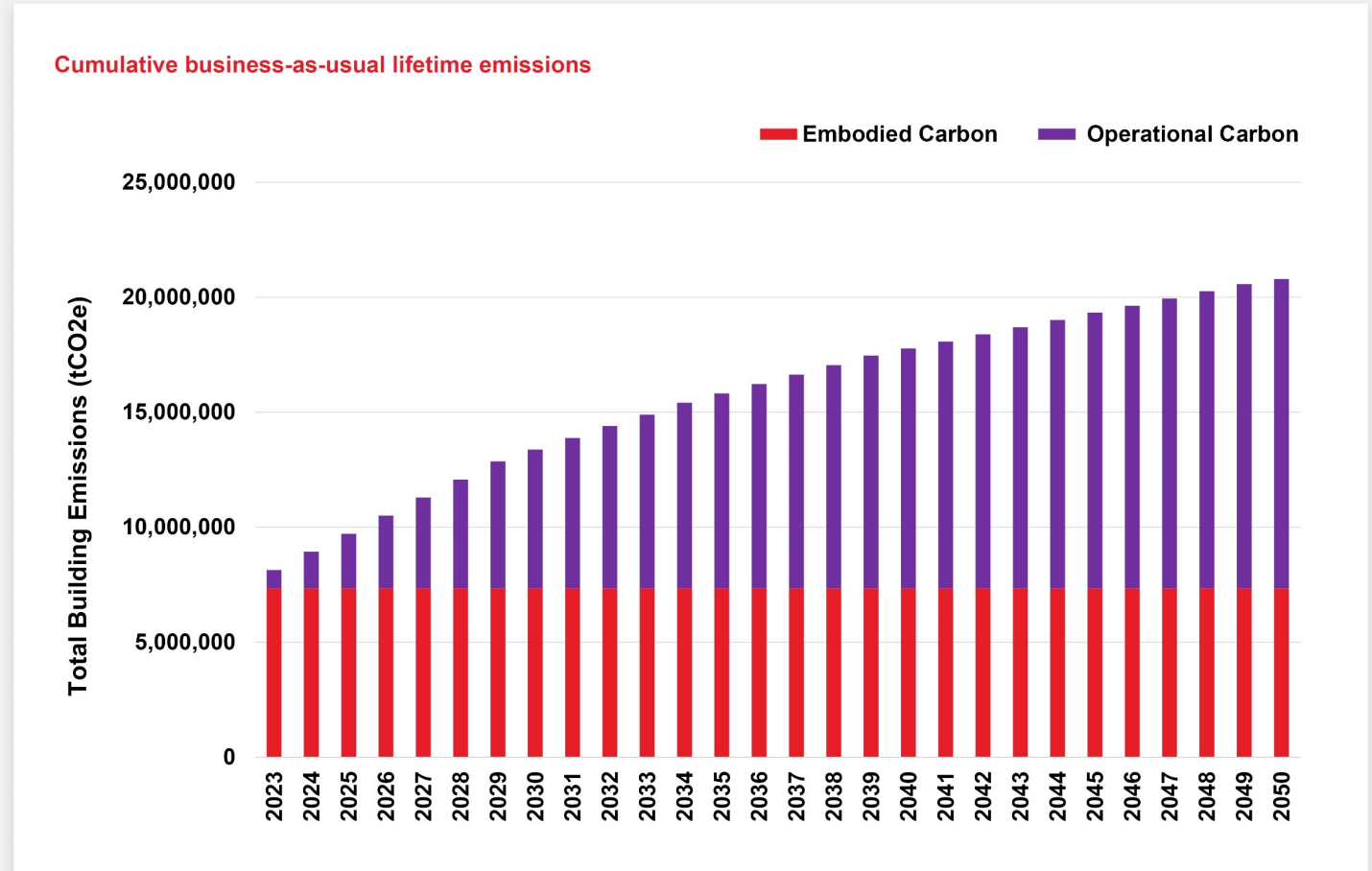
-12.9%

Reduce air infiltration

★ Triggered by Local Law 154 (Building Electrification)

Baseline Condition

- Business as usual baseline case in which the footprint of the additional homes are created from ground up new construction
- The 222 office buildings are left to operate as they do today

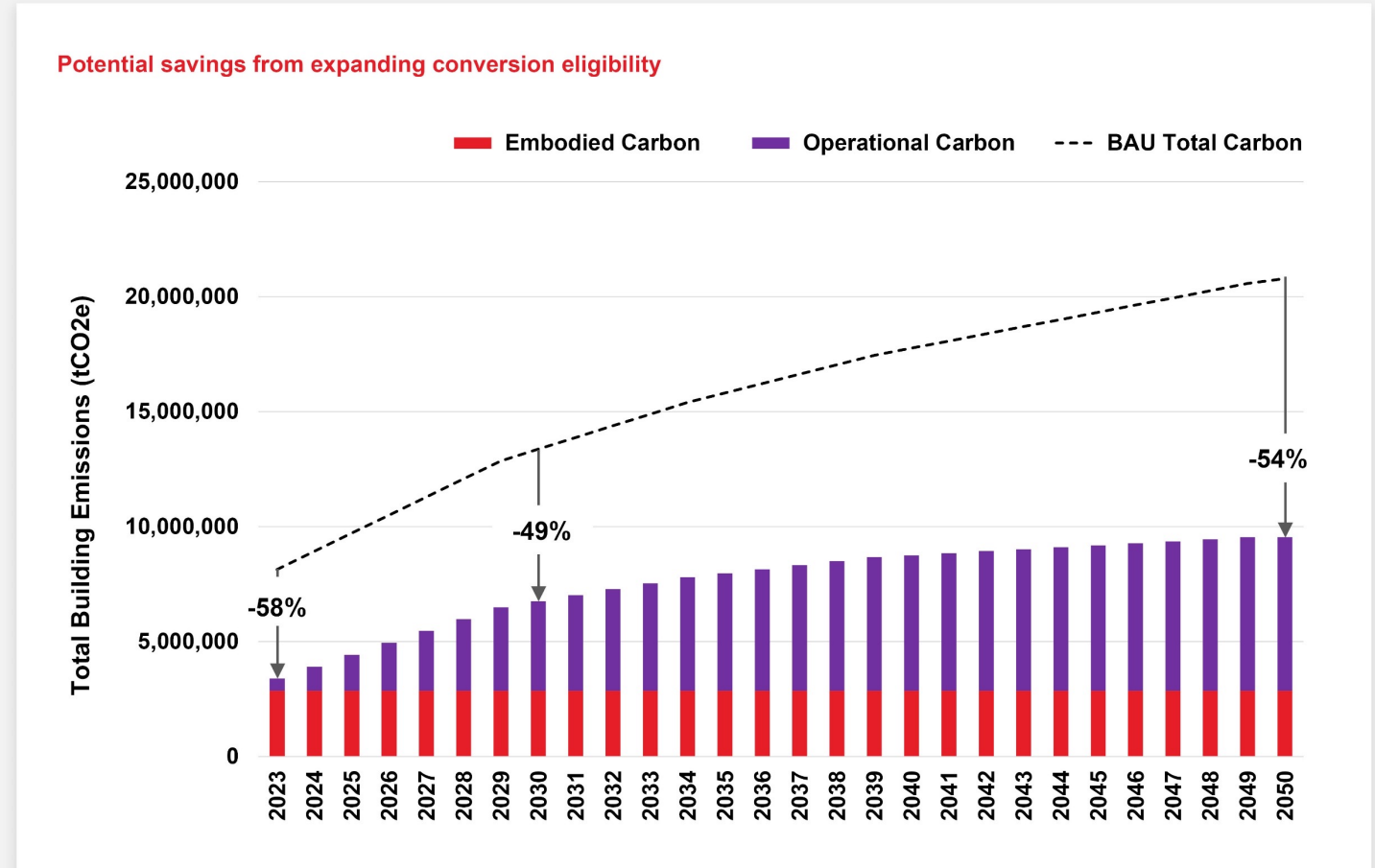


Embodied carbon: 149,015,772 sq. ft. of residential new construction

Operational carbon: Progression of current operational emissions for the 222 commercial buildings, with grid decarbonization

Results Summary | Savings

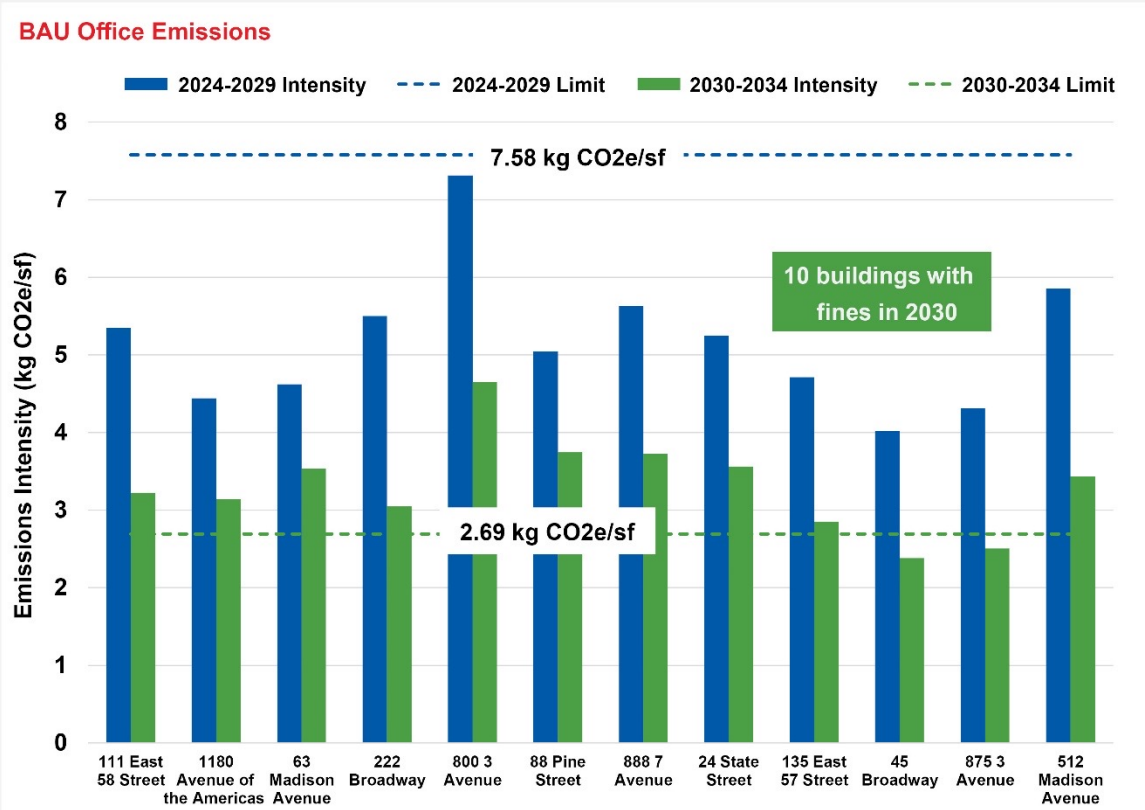
- Carbon savings that could result from conversions are the difference between this BAU case, and the case where the 222 buildings are reused and retrofit for residential use
- Expanding conversion eligibility could result in a **54% reduction in whole life carbon emissions by 2050**, below a BAU condition



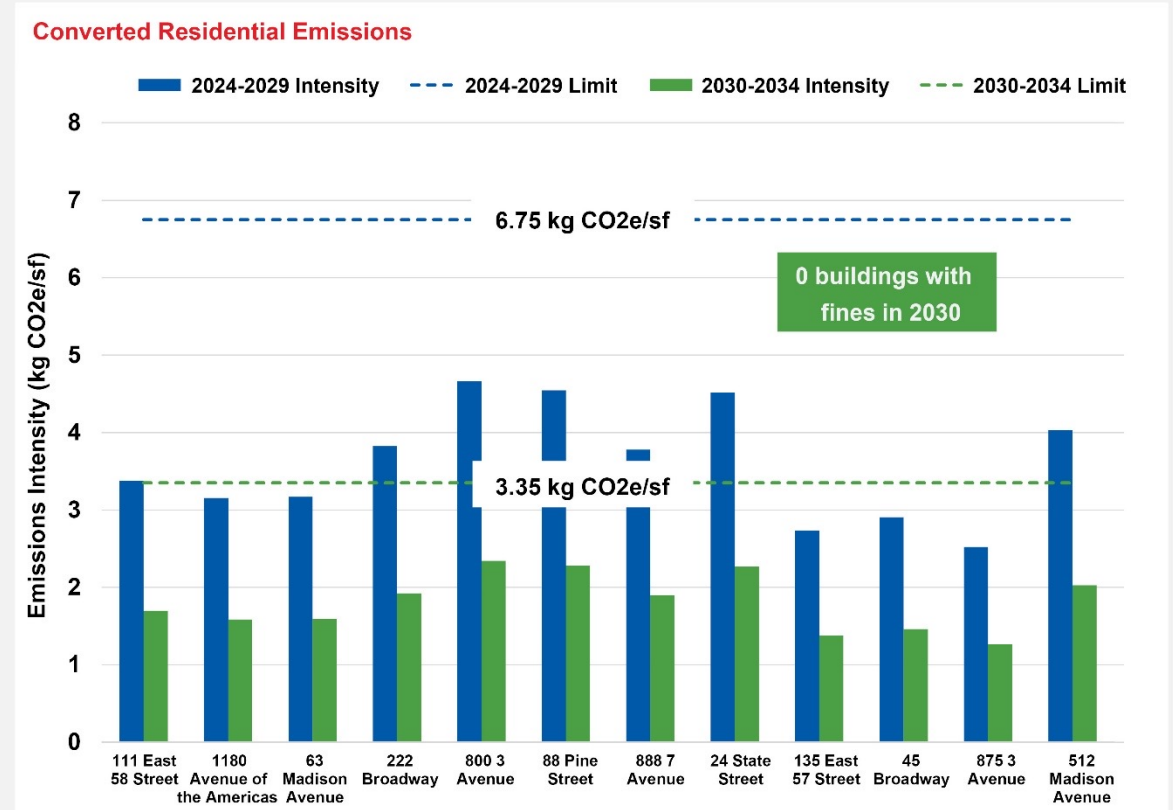
Embodied carbon: 149,015,772 sq. ft. of residential housing created from office to residential conversions instead of ground up new construction

Operational carbon: 222 existing office buildings are retrofit/electrified through conversion

Results Corollary 1: LL97 Implications



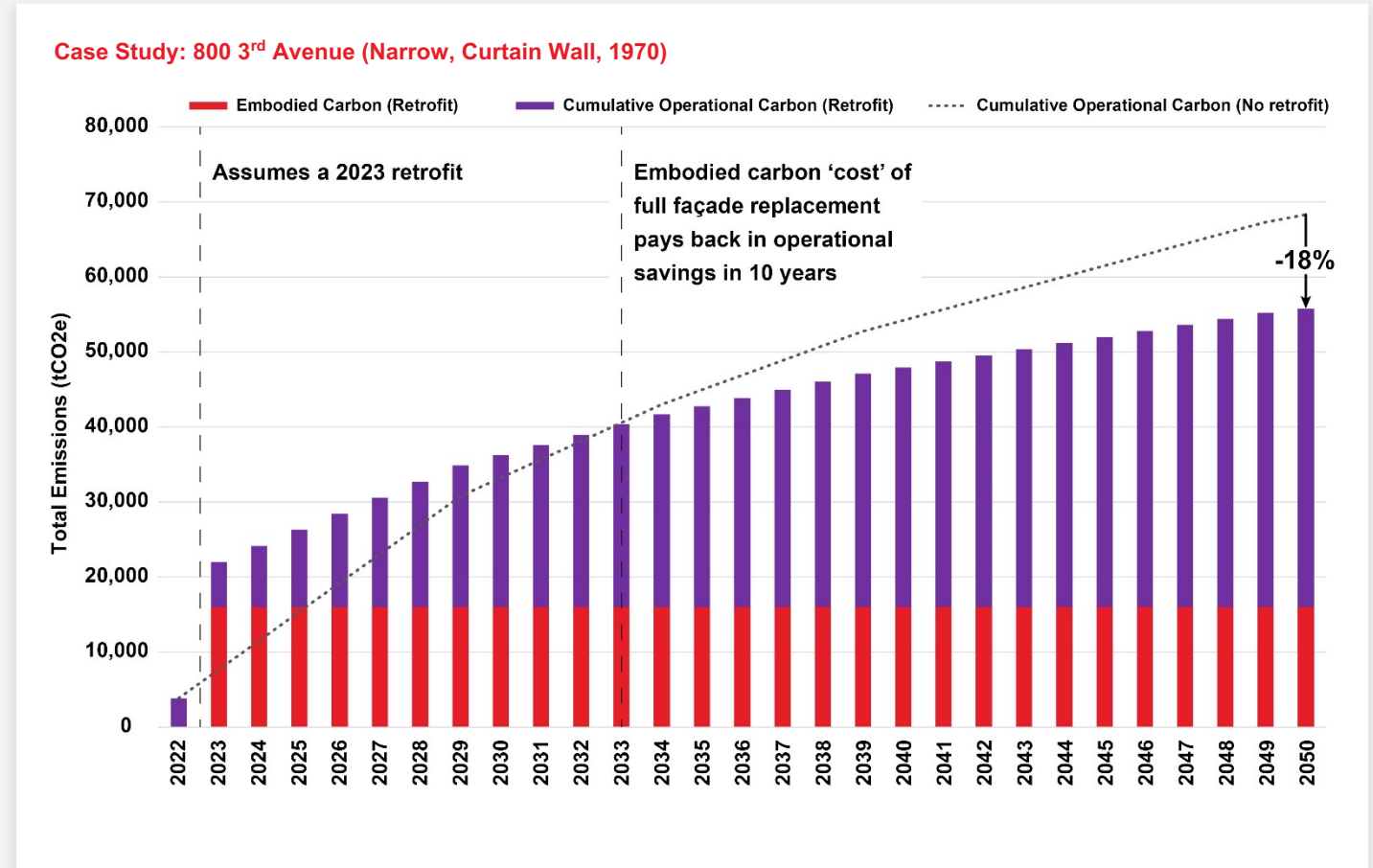
Existing office building performance for 12 selected typologies relative to LL97 office emissions limits.



Same 12 buildings after residential conversion, relative to LL97 multifamily housing emissions limits.

Results Corollary 2: Façade Replacement

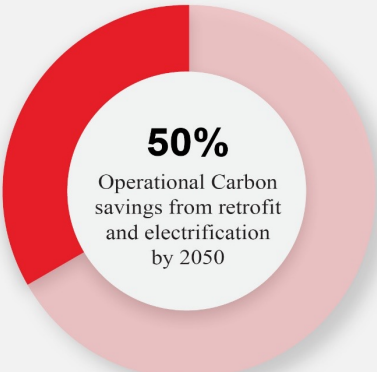
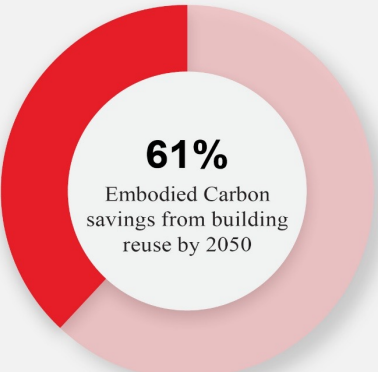
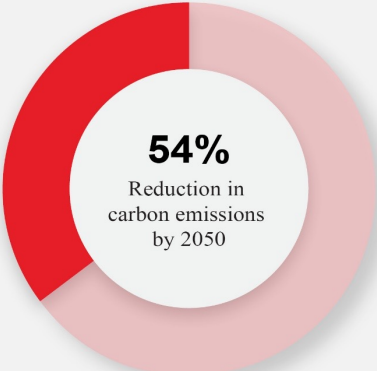
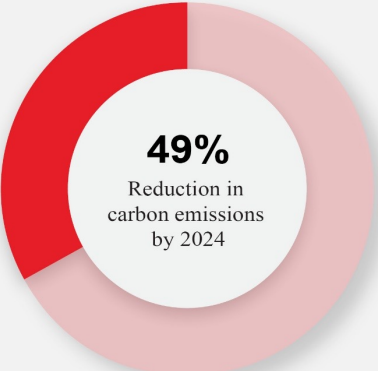
- Upfront embodied carbon ‘cost’ from a curtain wall replacement could pay back in operational efficiency in 10 years
- Could result in 18% savings in whole life carbon by 2050



Results Summary

This study provides an additional **carbon lens** through which policy makers and property owners can view the benefits of converting existing office buildings into residential use.

Based on the results of our calculations, the proposed zoning could save over 11 million tons of CO₂e by 2050, the equivalent of annual emissions from **2.3 million passenger vehicles**.




+149M sq. ft.
of housing for New Yorkers

-6.5Mt
of CO₂e by 2030

-11Mt
of CO₂e by 2050

ARUP

A photograph of a stone arch bridge spanning a river in a park during winter. The bridge is covered in snow, and the surrounding trees and ground are also blanketed in white. The sky is overcast and grey. A green rectangular box is overlaid on the center of the image, containing the text.

**Wishing you a safe and happy
holiday season!**

Thank you!



urbangreencouncil.org



[@UrbanGreen](https://twitter.com/UrbanGreen)

URBAN
GREEN