

**A
BETTER
CITY** 

BUILT TO LEAD:

LESSONS IN BUILDING DECARBONIZATION

DECONSTRUCTION & EMBODIED CARBON

LEARN MORE HERE



BUILT TO LEAD: LESSONS IN BUILDING DECARBONIZATION AND RESILIENCE

1. September 24, 2025, Built to Lead: [Lessons in Building Decarbonization in Existing Buildings](#)
2. October 30, 2025, Built to Lead: [Lessons in Building Decarbonization in New Construction](#)
3. December 18, 2025, Built to Lead: [Lessons in New Technologies and Opportunities](#)
4. **February 3, 2026, Built to Lead: Lessons in Deconstruction and Embodied Carbon, @ 10-11.30AM**
5. Built to Lead: Lessons in Resilience, late March/early April, 2026

AGENDA

- 10:00 AM **Kate Dineen, A Better City**—Welcome
- 10:02 AM **Yve Torrie, A Better City**—Introduction
- 10:06 AM **Irmak Turan, Arup**—*Circularity and embodied carbon at airports*
- 10:22AM **Dennis Carlberg, Boston University**—*Retrofit of BU's Warren Towers*
- 10:34 AM **Caroline Murray, Turner Construction**—*Deconstruction and reuse of office space*
- 10:46 AM **Andrew Thompson, Boston Building Resources**—*Material donation and reuse*
- 11.00 AM **Q+A**
- 11:30 AM **Event Concludes**

IRMAK TURAN, ARUP



A Better City Material Circularity and Reuse at Airports

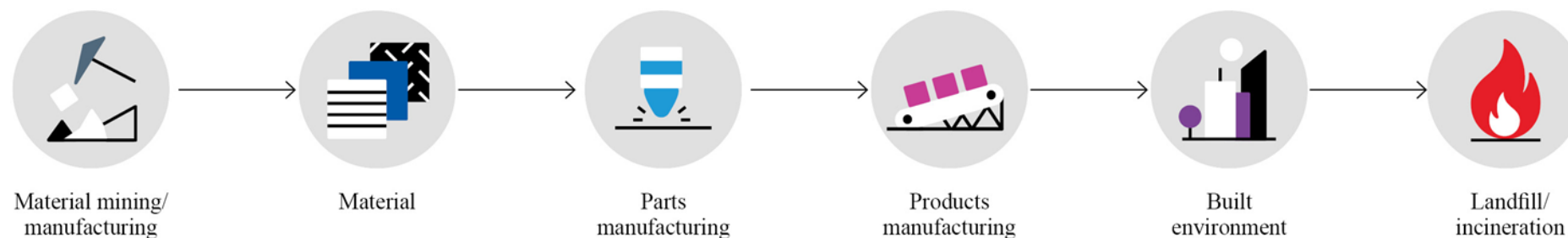
ARUP

Irmak Turan, Ph.D.
Associate | Climate and Sustainability
February 3, 2026

Image Credit: SFO

Circularity of Building Materials

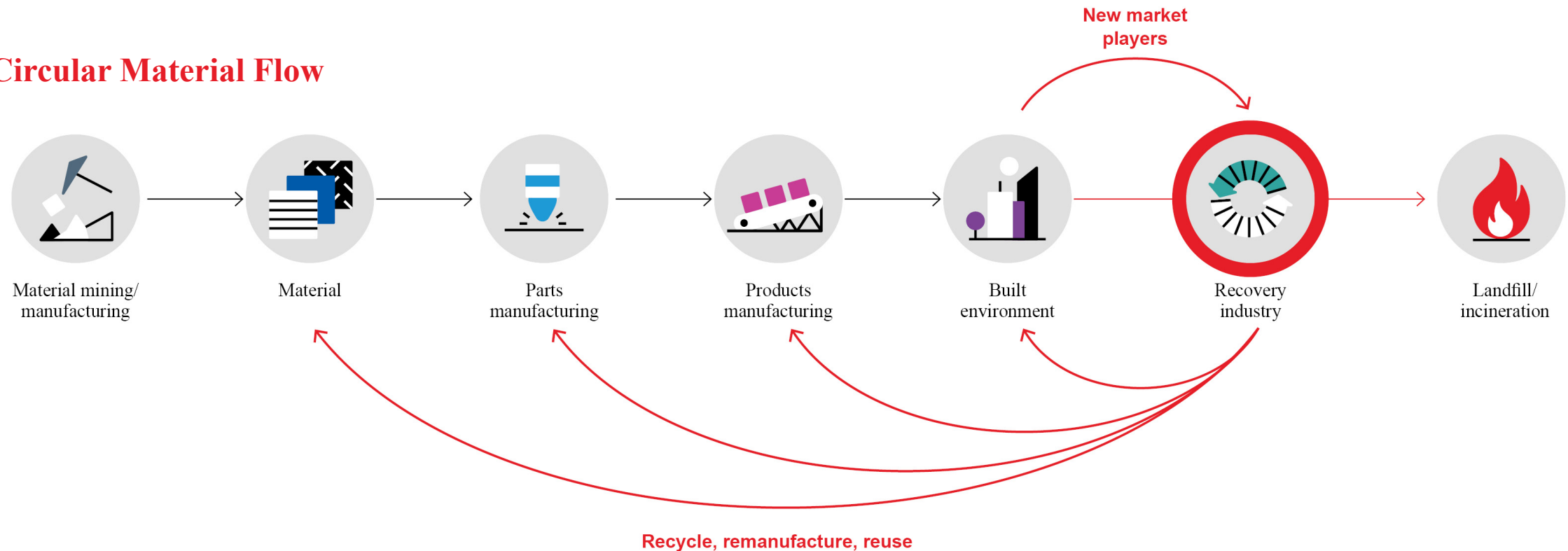
Linear Material Flow



Circularity of Building Materials

Circularity—in the context of building materials—refers to **designing, using, and managing materials in ways that maximize reuse, extend material life, and minimize waste**, thereby reducing overall environmental impact.

Circular Material Flow



A proposition...

Large portfolio owners—such as airport authorities, higher-ed campuses, and multi-facility organizations—are **uniquely positioned to benefit from circularity because they manage continuous, overlapping construction cycles.**

Large Portfolio Owners & Campuses

Consideration

On larger campuses there is concurrent construction activity happening at any given time



Opportunity

Multiple sources for material input and output

Because construction is happening in/near/around operational buildings, deconstruction (vs demolition) is common



Deconstruction, rather than demolition, is business as usual

San Francisco International Airport
Circularity Strategy for C&D Materials

Study Goal: **Grow SFO's circularity strategy for C&D materials** in alignment with the Airport's zero waste goals and its vision of becoming a circular airport.

Mapping Material Inputs & Outputs

Inputs (Construction Material Use)

vs

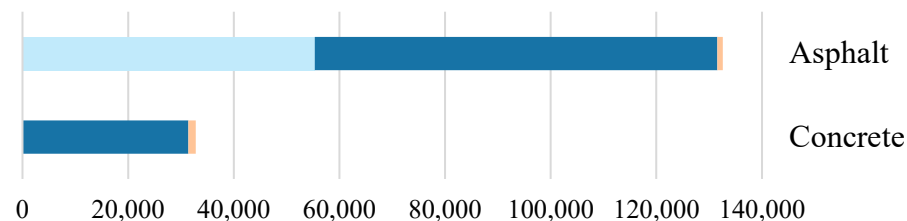
Outputs (Demolition Waste)



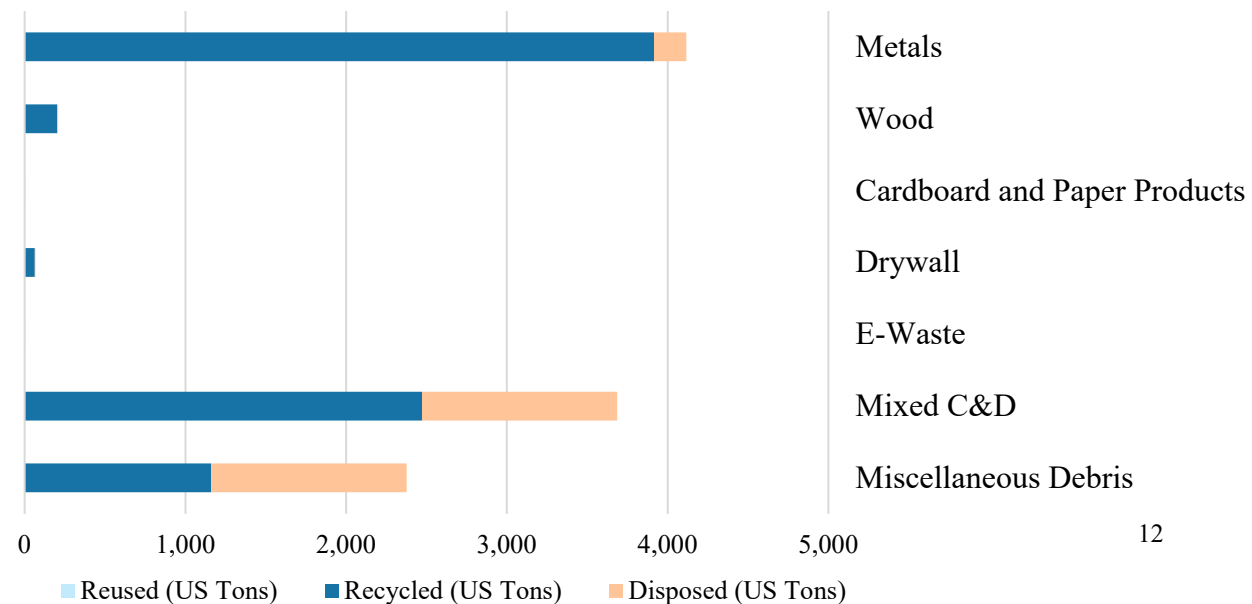
	Infrastructure Projects	Capital Projects	Tenant Improvements	Maintenance Projects	Useful Life (Years)	Purchase Costs (FY23/24)
Asphalt*	X	X		X	10-20	\$27M
Airfield and Construction Support Material	X			X	30	\$48M
Building Structural Materials	X	X		X	60	\$348M
Building Envelope Materials		X		X	40	\$188M
MEP Equipment	X	X	X	X	30	\$944M
Interior Construction		X	X	X	20	\$210M
Interior Finishes		X	X	X	10	\$158M
Fixtures, Furnishing and Equipment (FF&E)	X	X	X	X	10	\$191M

* This is only for the asphalt cover. It does not include the runway structure.

Diversion Rates: Asphalt and Concrete



Diversion Rates: Other Materials



Identifying Laydown & Storage Areas

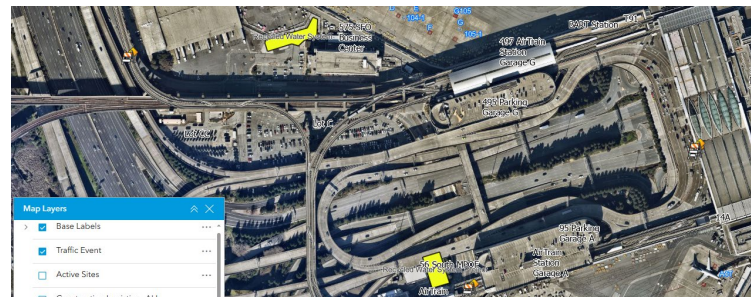
The study identified **~672,000 ft²** of total Laydown Area spread across the Airport.



North Campus Laydown Spaces
 Total Spaces: 12
 Total Area: ~335,000 ft²



Off Campus Laydown Spaces
 Total Spaces: 1
 Total Area: ~112,000 ft²



West Campus Laydown Spaces
 Total Spaces: 2
 Total Area: ~123,000 ft²

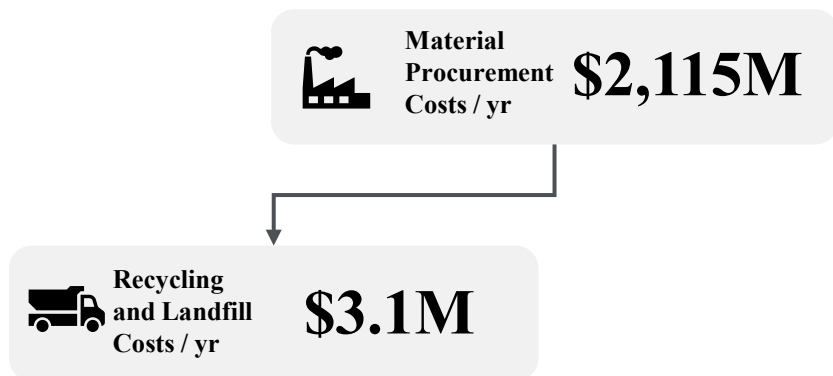


East Campus Laydown Spaces
 Total Spaces: 3
 Total Area: ~102,000 ft²

Potential Cost Savings

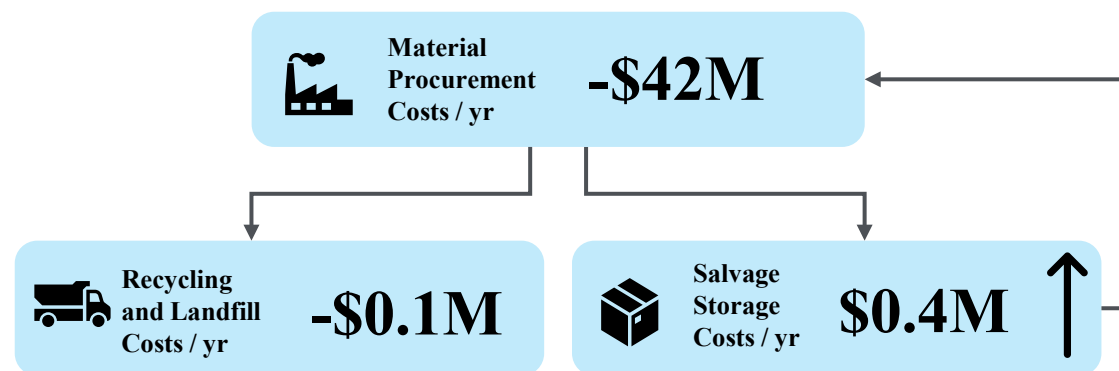
Business as Usual

annual material procurement costs for SFO
 VS
 annual demolition + hauling + tipping fees



Circular Model

reuse 2% of materials that have reached end-of-life
 in order to...
 reduce hauling & tipping fees +
 to save on new material procurement



Net \$41.7 Million in Estimated Savings

Recommendations



Develop a **C&D Circularity Plan** with clear roles, goals, and material budgets.



Establish a **Circularity Coordinator and department Circularity Champions** to lead implementation.



Improve **storage and laydown space management** using asset-management tools and external partnerships.



Define **material reuse criteria** and conduct early project team surveys to identify salvage opportunities.



Track **KPIs, material costs, and savings**, aligning procurement and waste-tracking systems.

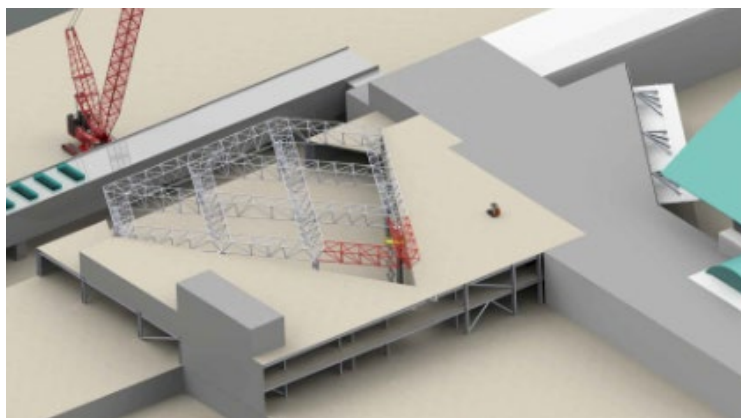
Steps after a high-level study...

- **Pilot Project:** Test recommendations made in a pilot project. Include a detailed data collection process to verify reuse rates and costs associated with more circular methods.
- **Life Cycle Assessment:** A life cycle assessment based on data collected from the pilot project to verify the carbon and cost savings of reuse over recycling.
- **Standards and Specifications Updates:** Consider opportunities to update the standards and specifications to implement circularity practices in the future.

Portland International Airport
Roof Truss Reuse

Steel Reuse Study at PDX

Savings of \$2-3M possible



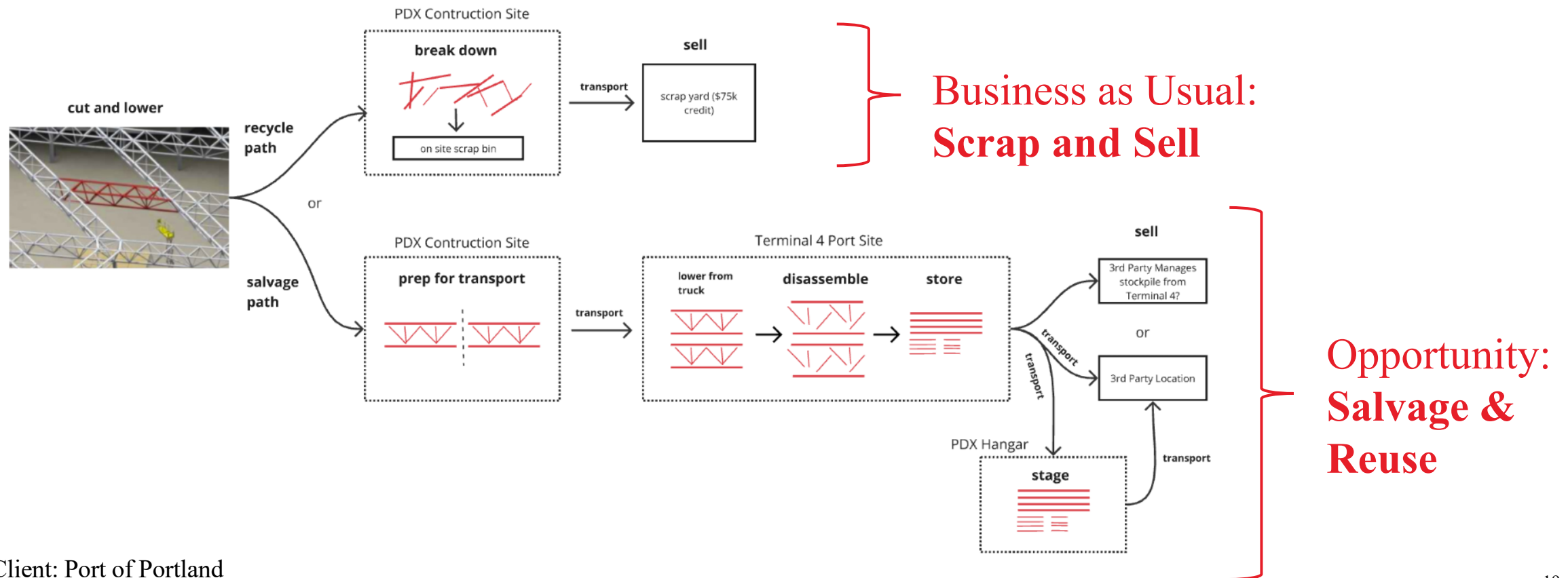
Proposed salvage & reuse of roof trusses in former security checkpoint



Client: Port of Portland
Team: Arup, Skanska, ZGF Architects

Deconstruction was already planned

Avoids a potential cost add for material recovery



Findings

\$1.5-2.7M in potential savings

Scenario	\$ Debit	\$ Credit	Total Cost Savings	Net Carbon Savings for reuse within 100mi (kgCO2e)	Steel Utilization Factor Assumed (%)
Scrap Steel	\$ -324,000	\$88,000	\$ -236,000	(48,796)	100%
Tube Reuse	\$ -389,000	\$1,838,000	\$1,449,000	413,607	70%
Truss Reuse	\$ -124,000	\$2,863,000	\$2,739,000	104,975	50%

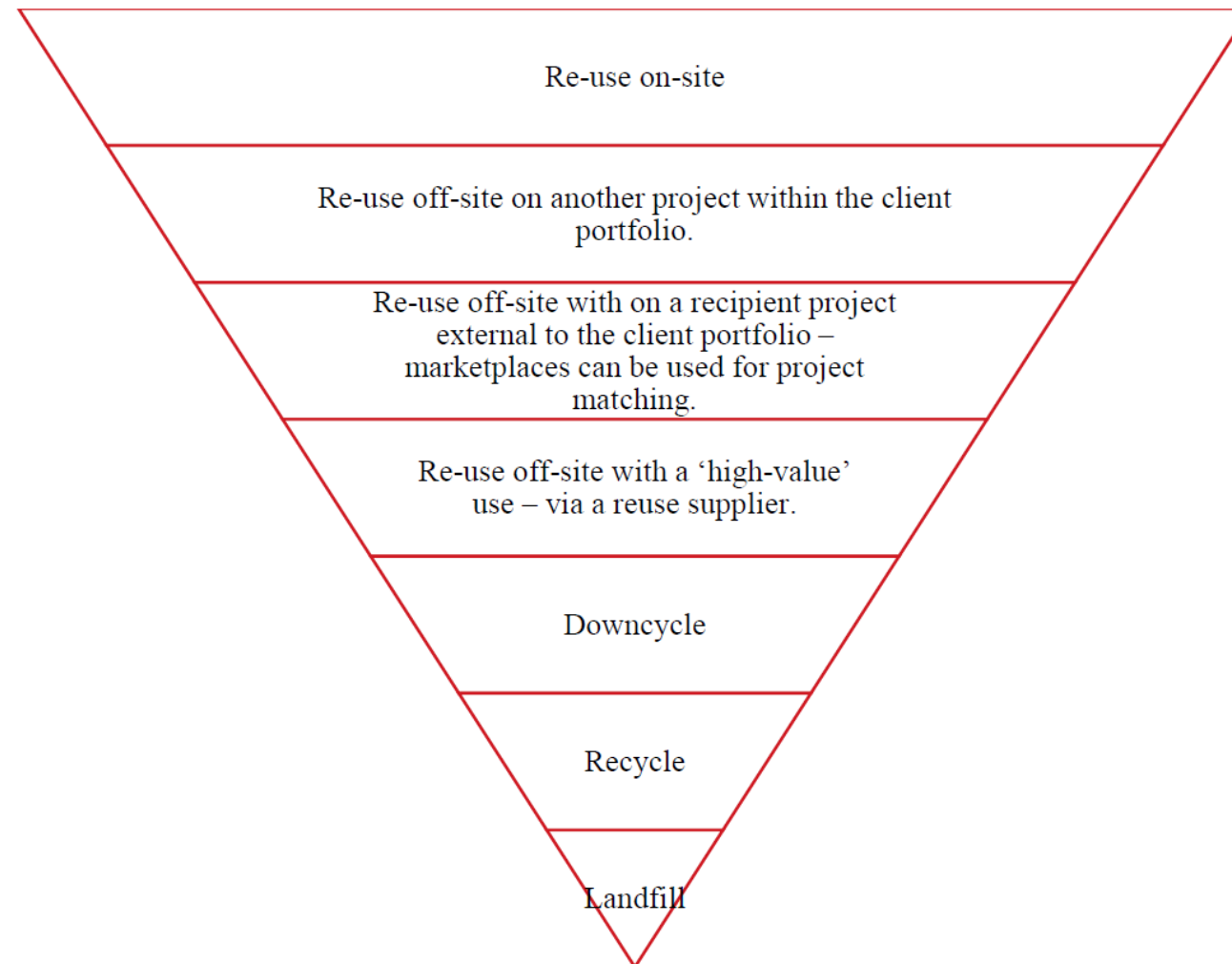
Tube Reuse: more potential reuse applications
 --
Truss Reuse: higher reuse value but fewer potential applications

Lessons Learned

- Savings from reuse of structural materials can be large
- Plan early to realize savings
- Identify storage areas (marine terminal, in this case)
- Get all participants on board (e.g. demo subcontractors)

Takeaways

Next Life Options for Reclaimed Materials



Takeaways and Considerations

1. Circularity Delivers Real, Measurable Value
2. Early Planning is Essential
3. Deconstruction Enables Reuse
4. Storage and Space Are Critical Infrastructure
5. Pilot Projects Build Confidence

We'd love to hear from you...

Irmak Turan, Ph.D.

Associate | Climate and Sustainability

irmak.turan@arup.com

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Arup's Circularity Resources:

- [Circular Buildings Toolkit](#) (online resource)
- [The Reuse Playbook](#) (Arup, 2025)
- [Applying Circularity in the Life Cycle Assessment of Buildings](#) (Arup, 2024)
- [Unlocking Value in Buildings: Developing the business case for building circular](#) (Arup, 2025)

ARUP

DENNIS CARLBERG, BOSTON UNIVERSITY



Climate Action

Acting on Indirect Emissions

Lessons in Building Deconstruction and Embodied Carbon Panel
A Better City

February 3, 2026



Climate Action Plan - Goals

1

Prepare
for
Climate
Change

2

Net Zero
Direct
Emissions
by 2040

3

Act on
Indirect
Emissions

Climate Action Plan - Actions

1

Prepare

Building above
Elevation of
Resilience

2

Net Zero

Reduced
emissions by 66%

BU Wind matches
100% of electricity

3

Indirect

Embodied Carbon
New construction
Adaptive Reuse
Sustainable
purchasing

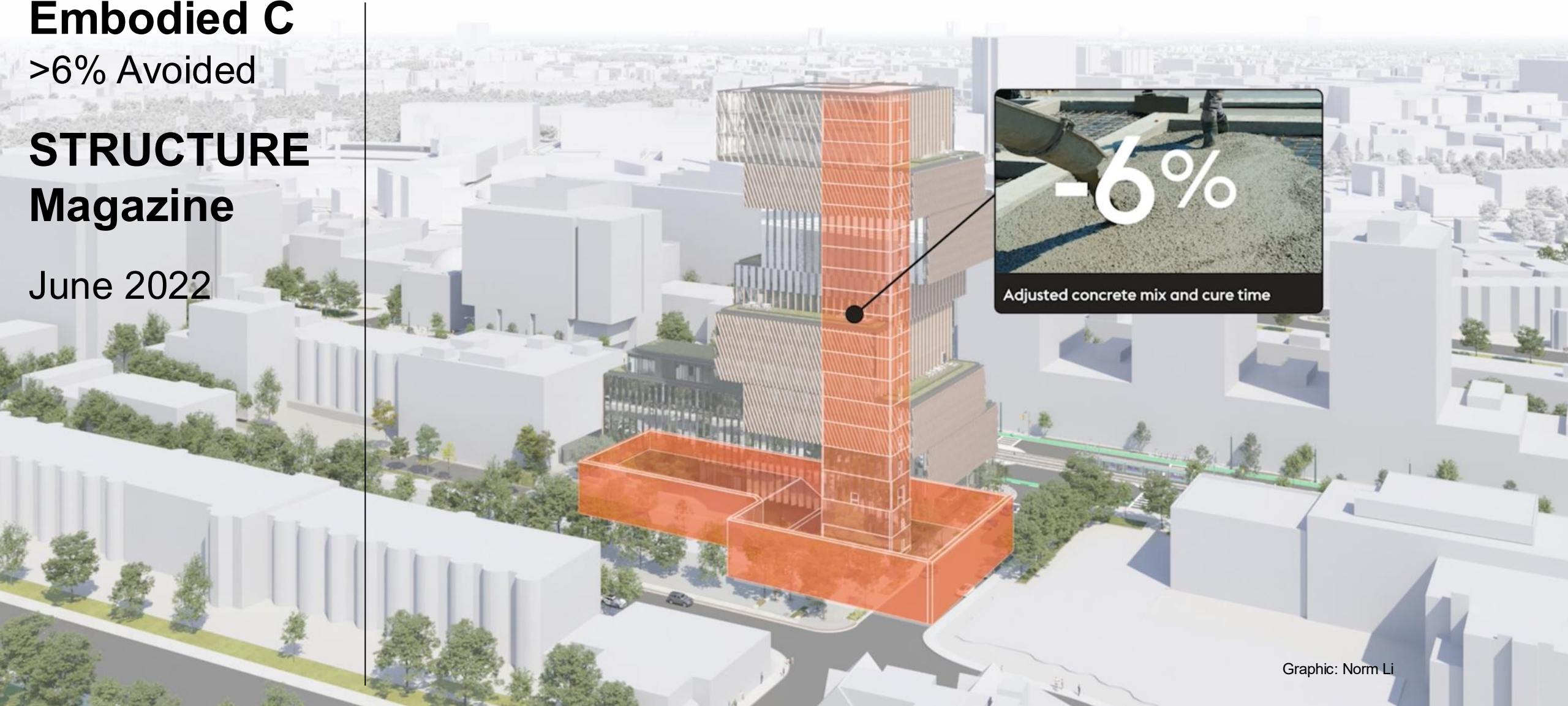
Center for Computing & Data Sciences

Embodied C

>6% Avoided

STRUCTURE
Magazine

June 2022



-6%

Adjusted concrete mix and cure time

Pardee School of Global Studies

Embodied C
>30% Avoided



Rendering: Diller Scofidio + Renfro

Warren Towers

Area

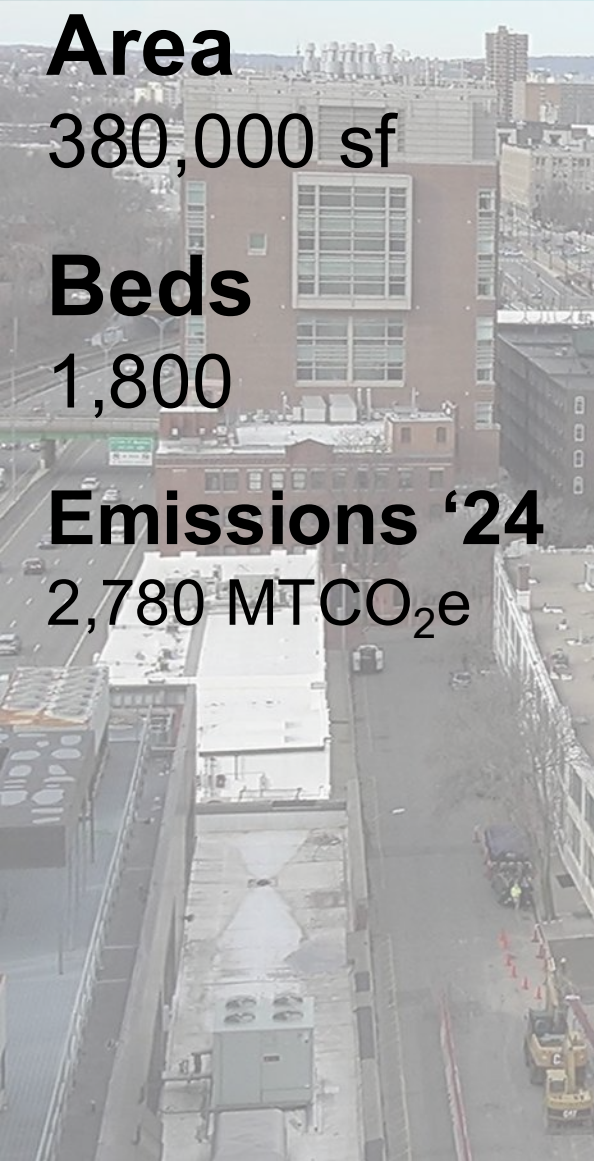
380,000 sf

Beds

1,800

Emissions '24

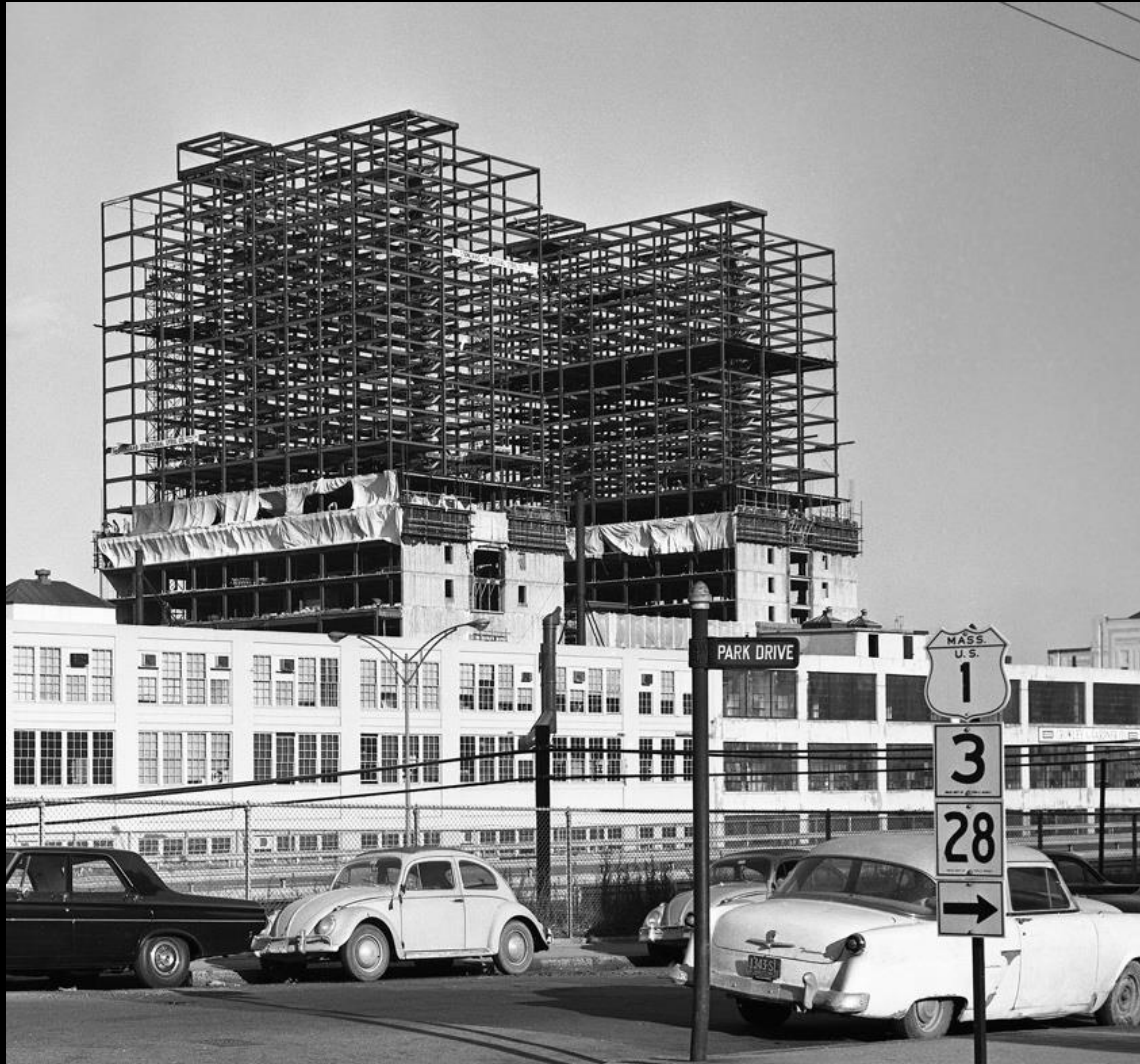
2,780 MTCO₂e



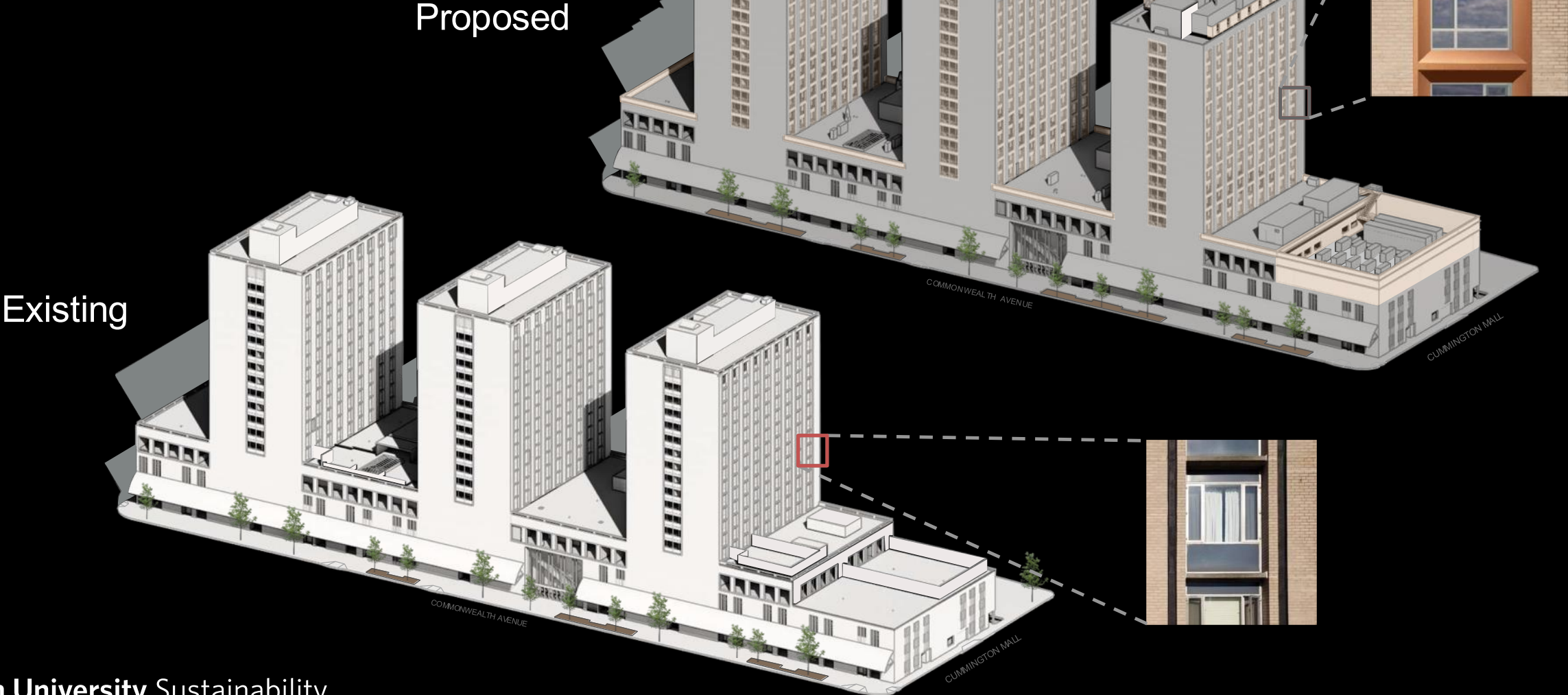
Net Zero Operational Carbon



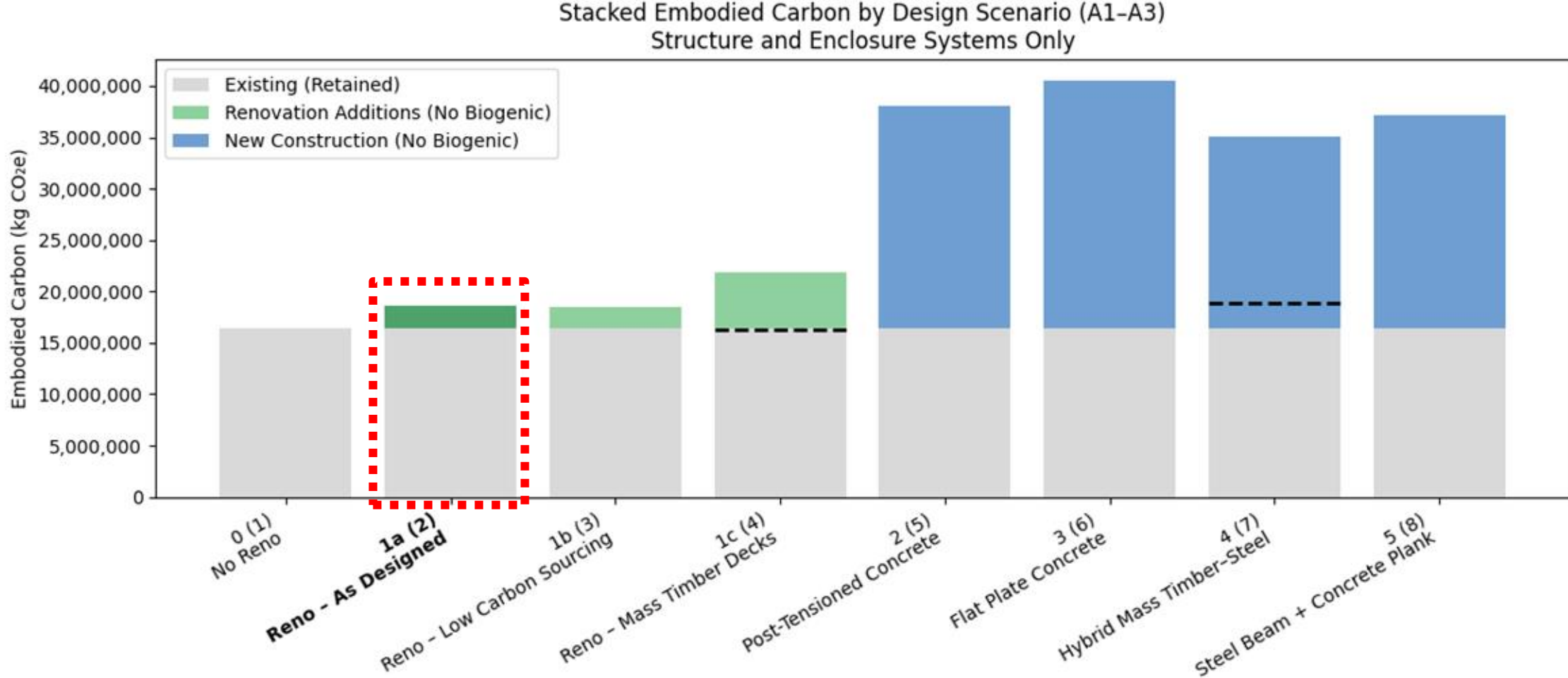
Embodied Carbon



Embodied Carbon

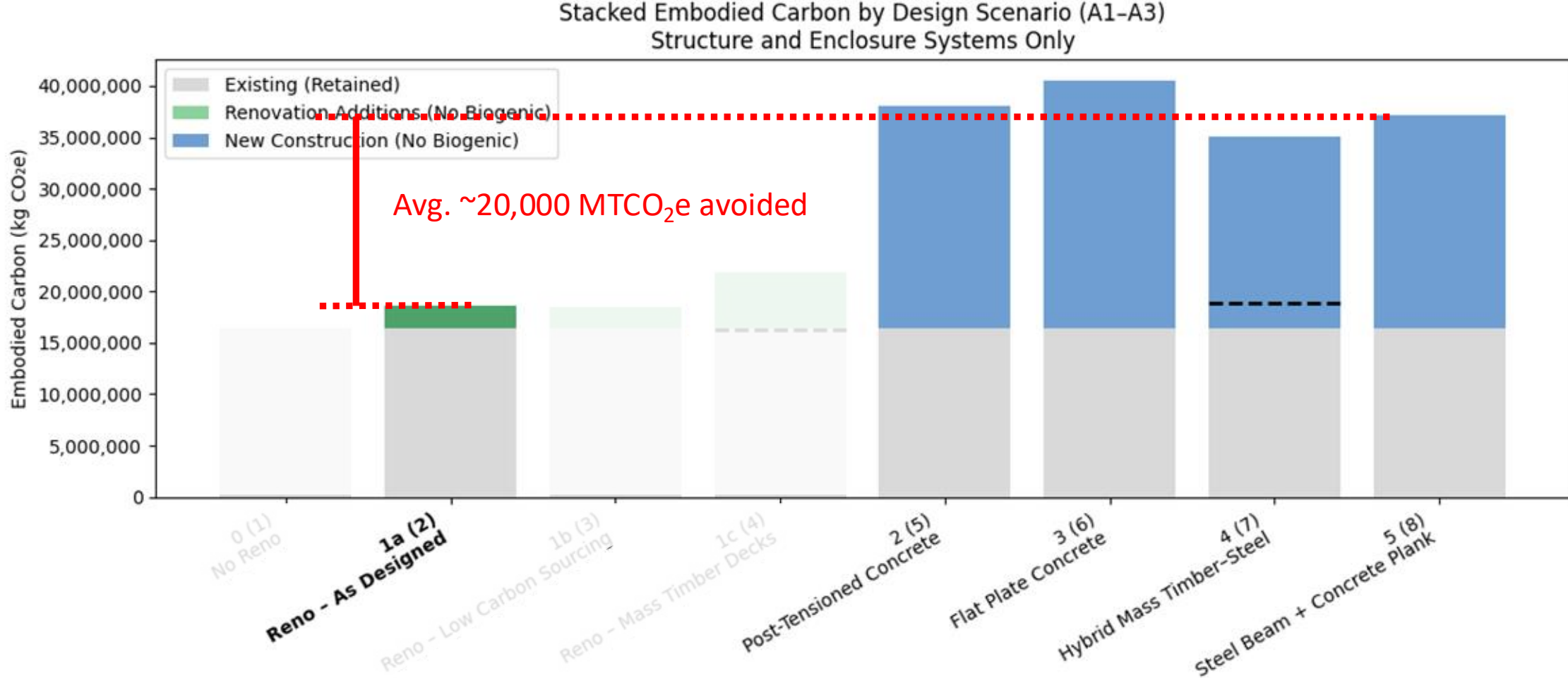


Embodied Carbon



Notes:
 1. Dashed lines indicate scenarios including biogenic carbon uptake (A1-A3 only). Results reflect product-stage impacts only; end-of-life emissions are not shown.
 2. New construction scenarios do not include demolition of the existing Warren Towers, which would increase the embodied carbon impacts shown.

Embodied Carbon



Notes:
 1. Dashed lines indicate scenarios including biogenic carbon uptake (A1-A3 only). Results reflect product-stage impacts only; end-of-life emissions are not shown.
 2. New construction scenarios do not include demolition of the existing Warren Towers, which would increase the embodied carbon impacts shown.

Core Findings: Renovation Wins

- Renovation avoids ~20,000 metric tons CO₂e
- Average new construction results in 6 - 10x more embodied carbon than renovation
- Even lower-carbon new buildings cannot easily outperform reuse
- The carbon cost is driven by new foundations, full material replacement, and larger building area

Time Matters: Carbon Payback

- Embodied carbon is emitted up front - before occupancy
- Renovation carbon is worth ~1 year of existing operations
- New construction requires 7 - 9 years to pay back
- The operational carbon for Warren will be net-zero –
 - All the emission from this building will be its embodied carbon

Warren Towers off Carbon

EC Avoided

~20,000 MTCO₂e

or

6 – 10 x new
construction

Emissions '24

2,780 MTCO₂e

Emissions '29

Zero MTCO₂e



Embodied Carbon

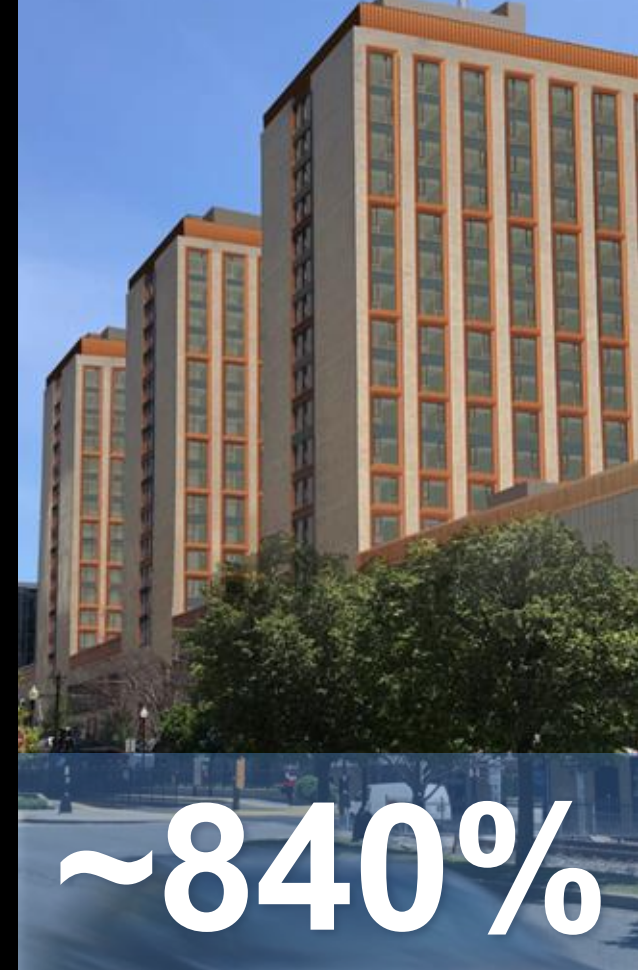
Duan Family Center for Computing
& Data Sciences



Pardee School for
Global Studies



Warren
Towers



Looking Ahead

BU Climate Action Plan update

- CAP 1.2 Working Group
- Exploring recommendations for Embodied Carbon:
 - Reduction targets (percent)
 - Time scales
 - Building types
 - Campus wide carbon budget (kgCO₂e/sf)
 - Integration with the planning process
 - Integration with construction standards for early decision-making
 - Track progress tied to operational emissions
 - Thoughtfully, transparently, and collaboratively contribute to help move the industry forward

Thank You.



CAROLINE MURRAY, TURNER CONSTRUCTION COMPANY



Turner



Caroline Murray
Regional Sustainability
Manager
She/her



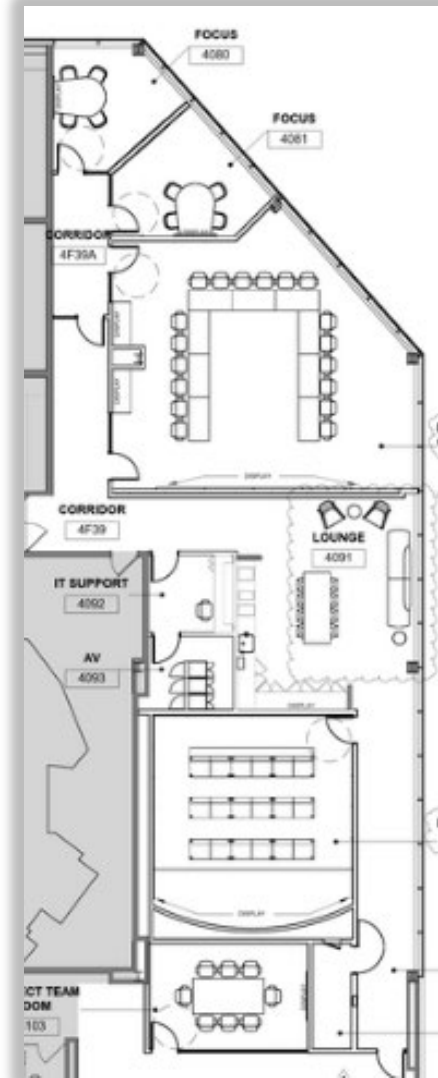
A Better City Panel: Deconstruction & Reuse Playbook

February 3rd, 2026

Confidential Project Description

BACKGROUND

- ~4,000 sq. ft.
- Located in Suburban Boston
- Tenant relocation from adjacent building
- Similar usage & headcount to former space
- Point-to-point move with no intermediate warehousing





**Demountable
Door**

Demountable Glass

Demountable Frame

DEMOUNTABLE PARTITIONS

Win

- Material cost savings
- Zero lead time
- Plate glass is not recyclable in MA

Why it Worked

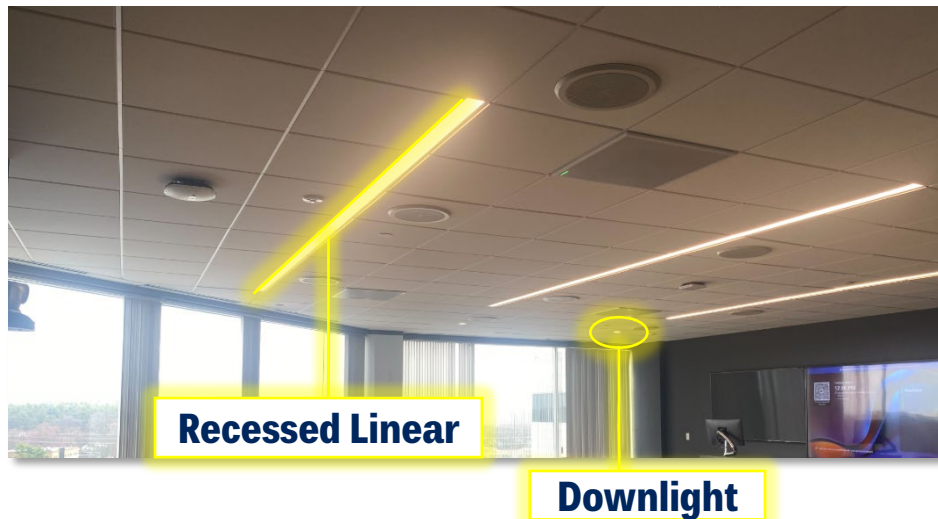
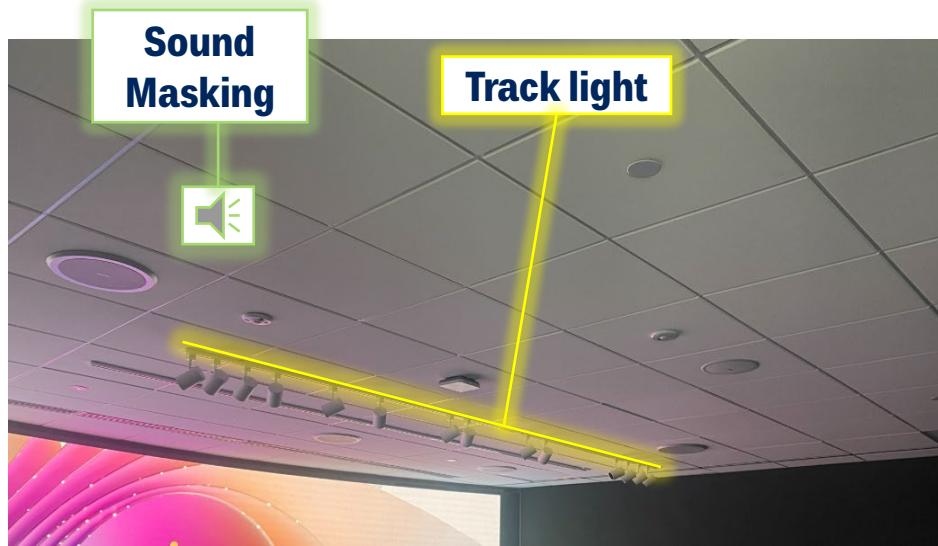
- System manufactured for reconfiguration
- Designer buy-in for dimensional flexibility

The Catch

- Confirm components align with design intent

Turner Control Point

- Accurate audit of available components vs. final design
- On-site material storage, protection, & labeling



LIGHT FIXTURES

Win

- Material cost savings
- Zero lead time
- Reuse of hard-to-recycle components

Why it Worked

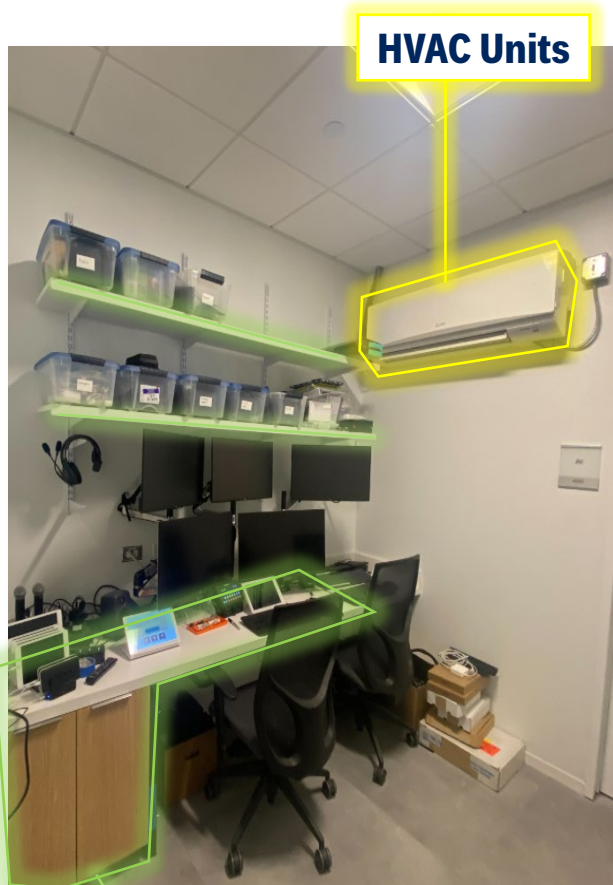
- Salvaged fixtures met design intent
- Trims compatible with existing ceilings

The Catch

- Driver & controls incompatibility

Turner Control Point

- Cost for repairs, adjustment, & reconfiguration
- Cost for replacement fixtures at prior location



HVAC Units

Lower cabinet, counter, shelving

BACK OF HOUSE & ROOFTOP

Win

- Material cost savings
- Zero lead time; new HVAC units would not have met schedule
- Freed design, engineering, & fabrication effort for higher-impact work



HVAC Units

Why it Worked

- Client & designer buy-in on finishes for non-client facing areas

The Catch

- Equipment warranty forfeited
- Obsolete refrigerants

Turner Control Point

- Coordination of dimensions & blocking
- Hygienist cleaning of reused equipment



AV EQUIPMENT & CARPET

Win

- Material cost savings
- Zero lead time
- Reuse of hard-to-recycle AV equipment
- Use of attic stock frees up storage space

Why it Worked

- Client attic stock met design standards
- Designer sized layout to accommodate

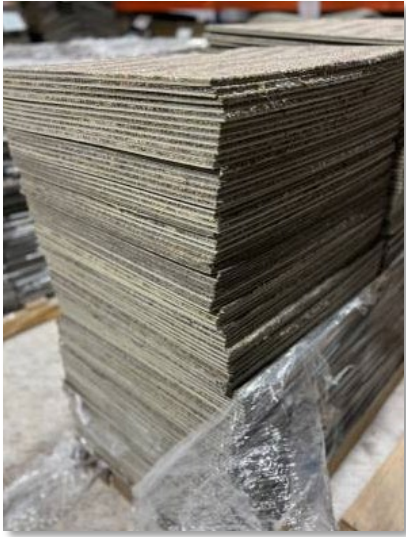
The Catch

- None!

Turner Control Point

- Floor box sizing

**Attic Stock
Carpet Tiles**



Existing Shaw Carpet Tiles (palletized after salvage)

CARPET & CLEAN GYPSUM

Win

- Circulatory: materials are back to the supply chain
- Dumpster cost savings

Why it Worked

- Massachusetts ban on landfill disposal of clean drywall
- Established carpet manufacturer takeback program

The Catch

- Labor cost for separation & palletizing
- Site separation can congest jobsite

Turner Control Point

- Staff coordination with manufacturers



Clean GWB Offcuts



Fabric Panels



**Specialty
Ceilings**

SPECIALITY FINISHES

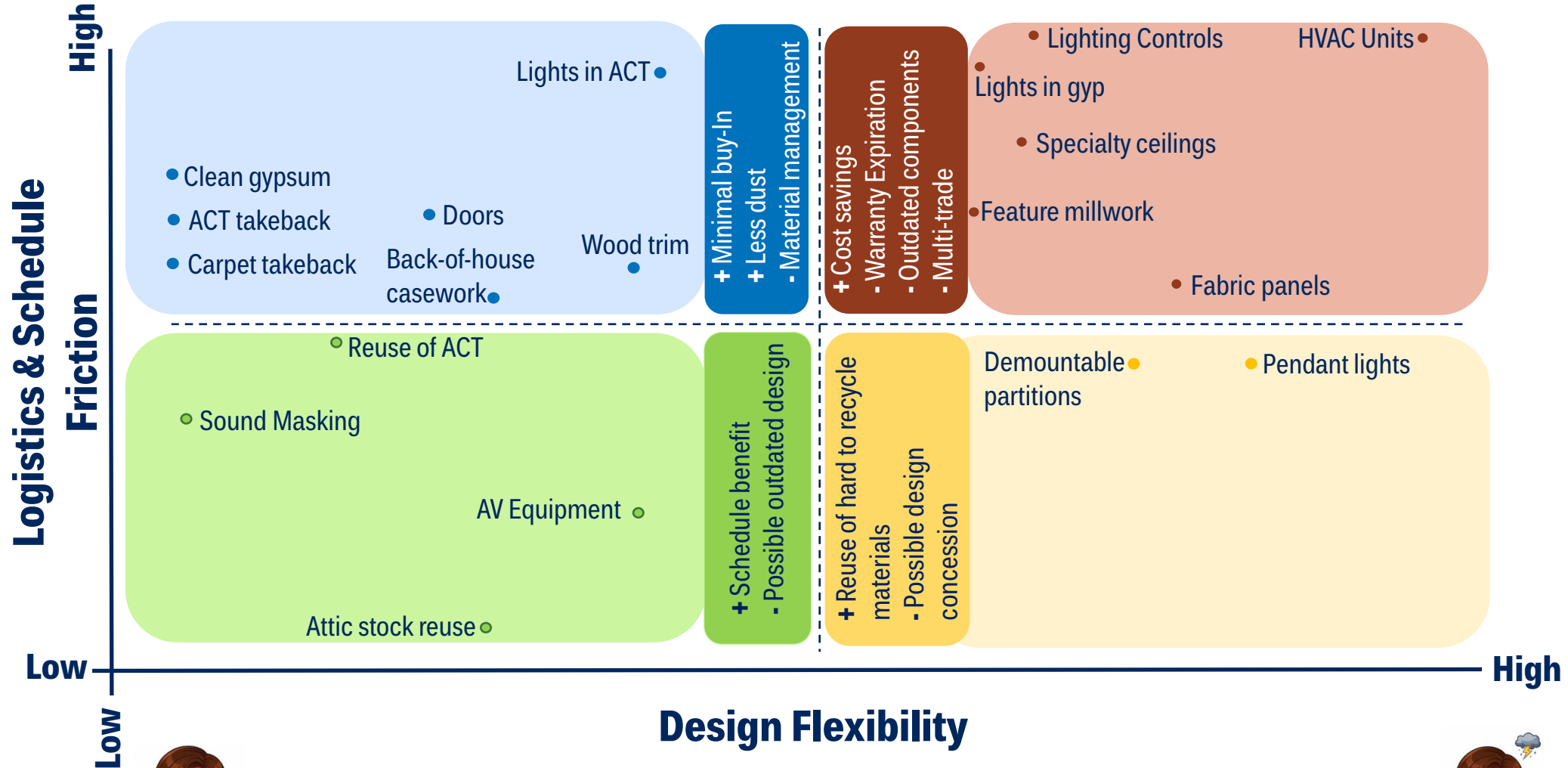
Why it didn't work

- Limited secondary use or resale market for finishes with penetrations/cuts
- Not cost effective

Turner Control Point

- Assess quality & quantities early for potential reuse

Reuse Feasibility Matrix



Turner

The image shows a modern office environment with glass-walled cubicles. In the foreground, a blue semi-transparent overlay covers the bottom half of the frame. The background shows office desks, chairs, and a colorful piece of art on the wall.

Q & A

ANDREW THOMPSON, BOSTON BUILDING RESOURCES



Boston Building Resources – Reuse Center



We empower people to build equitable, sustainable, and strong communities through material reuse and education.

Who are we?

- Nonprofit focused on building material reuse and education
- Founded in 1981, Reuse Center opened in 1993
- Over 5,000 customers, donors, workshop attendees, etc. in 2025
- Serving homeowners, renters, contractors, designers, etc.
- Store open to the public
 - Program for low-income customers to get deeper discount
- Deconstruction services and educational workshops
 - Home improvement skills and concepts, art making/creative reuse, intro to tools for women, etc.

New kitchens = a lot of saddle time

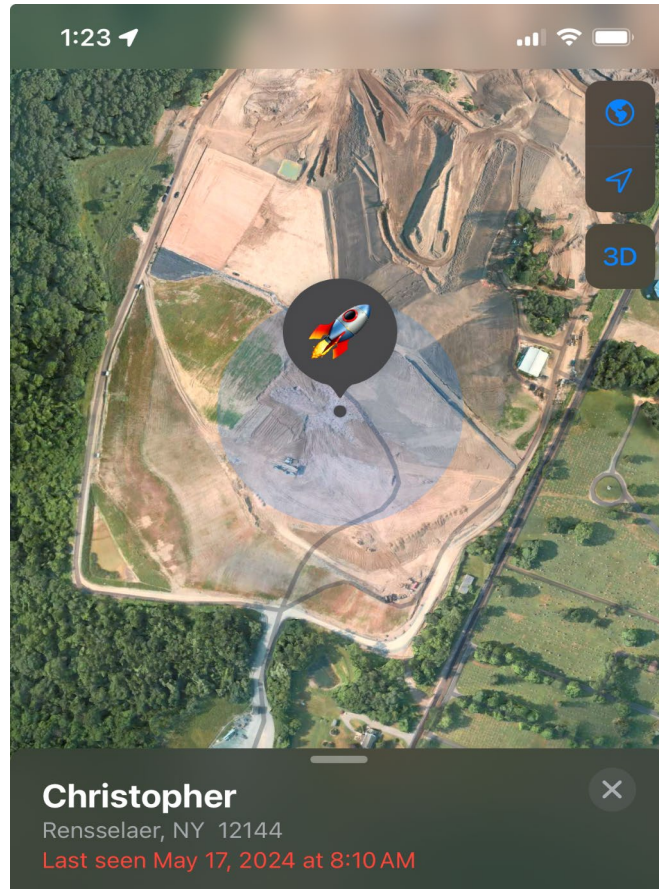


10 feet of upper & lower cabinets + solid surface manufactured countertop = 5 tons CO2

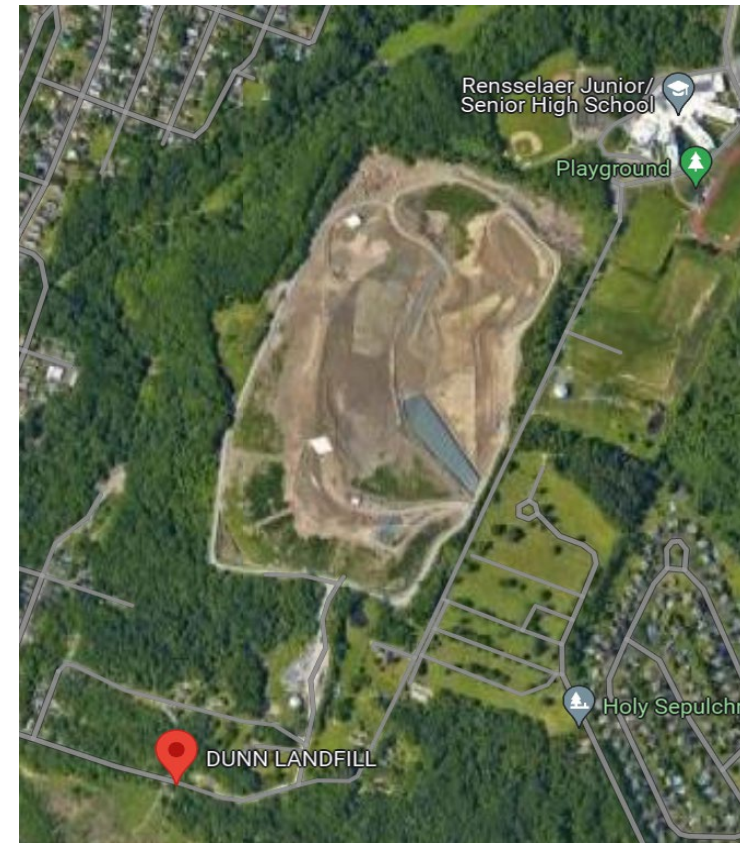
Bicycle 100 miles every day for a year CO2

5 tons CO2 = or

Bicycle from Boston to Montreal and back 53 times.



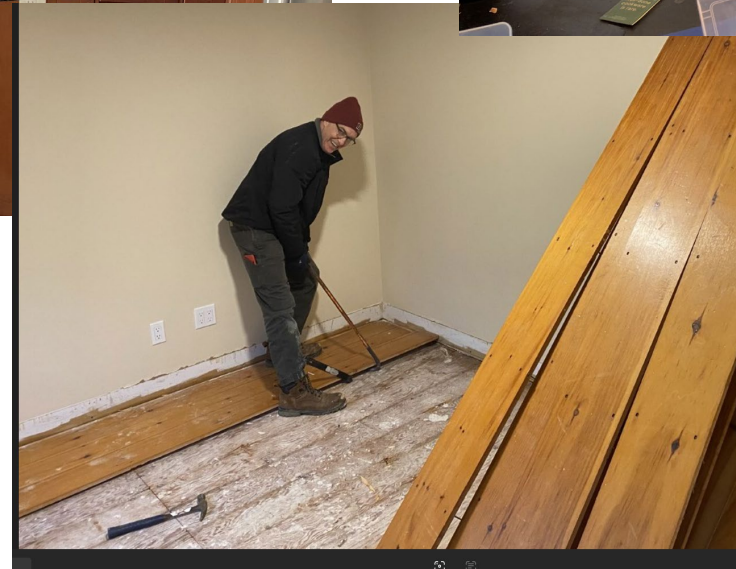
Location of "Christopher", the Apple GPS Tracker



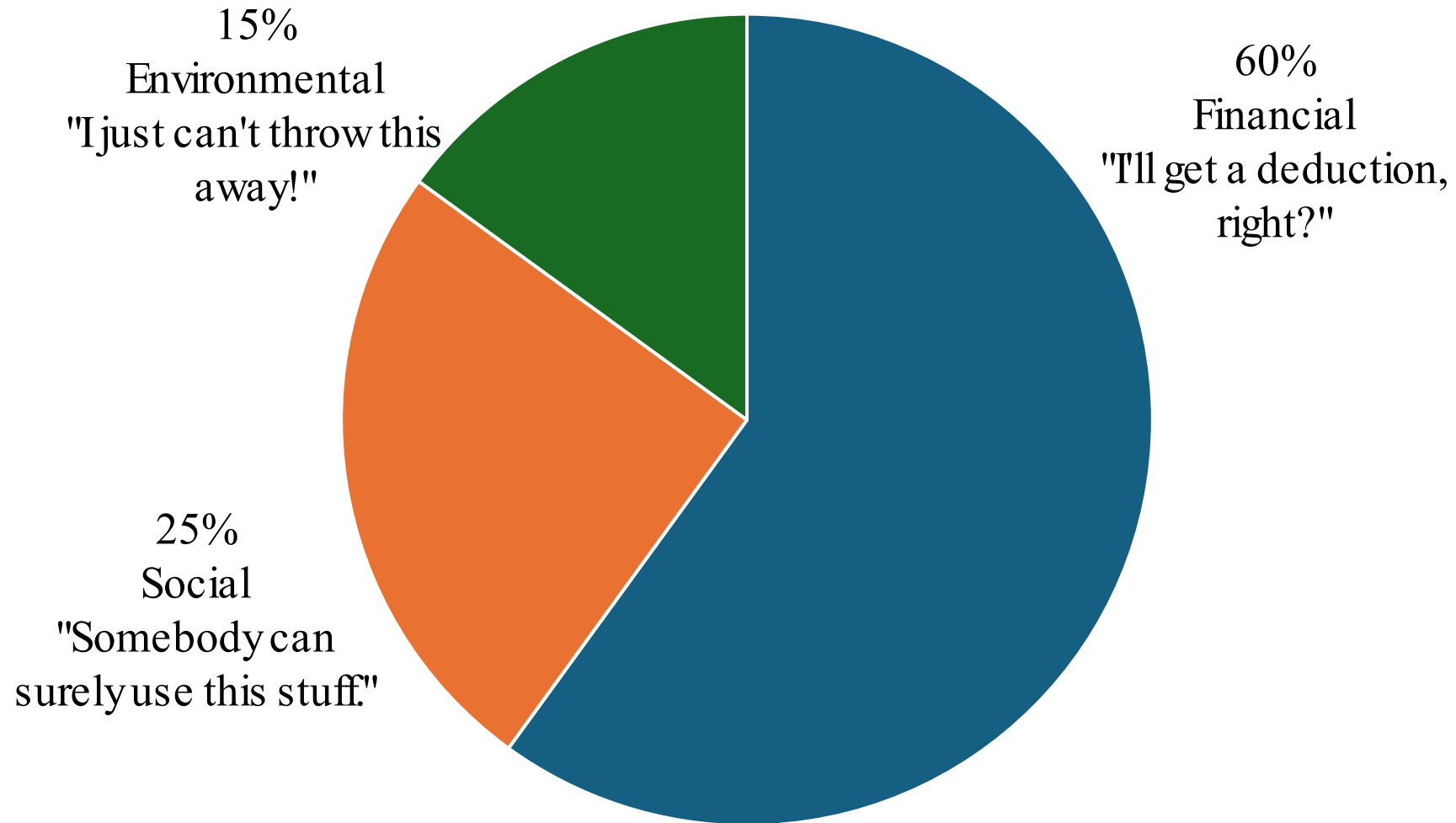
Google Maps

Since the landfill began operations in 2015, the residents of Rensselaer have been subjected to the rotten egg odors caused by hydrogen sulfide gas released from rotting drywall in the landfill. Dust from the dump frequently envelopes the school and surrounding homes. Each weekday, beginning around 6:40 AM, dozens of long-haul tractor trailer trucks coming from seven states roar up through residential areas of Rensselaer on their way to and from the dump, disturbing residents and exposing them to dust, loud noise, and diesel exhaust. ---- [Dunn Landfill - Rensselaer Environmental Coalition](#)

Deconstruction as a viable alternative to disposal



Motivations for Choosing Deconstruction



Desirable Materials

Condition

Quality

Utility / Alternatives

Architectural integrity

	<u>% of BBR sales</u>	<u>Utility</u>
Cabinets	15-20%	High
Appliances	10-15%	High
Windows	8-12%	Medium
Doors	8-10%	Medium
Plumbing	4-8%	High
Housewares	4-8%	Low
Lighting	1-3%	Low

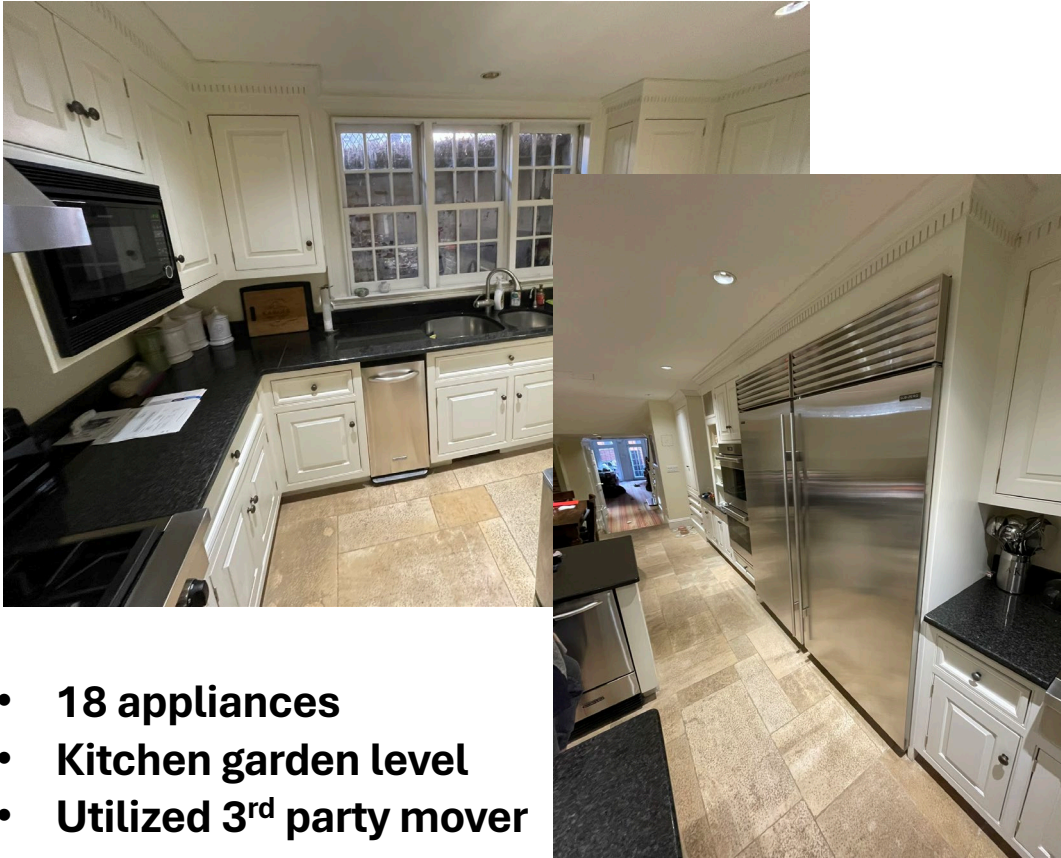
Challenges

- Lack of deconstruction contractors/reuse partners
- Developing market for secondhand building materials
- Project planning hurdles
- Storage and staging place for salvaged materials
- Complexity and long timelines in commercial building sector

Opportunities

- Small victories are easy to come by and simple to execute
- Long planning process provides time to line up reuse partners
- Market differentiation—commitment to the basic sustainable practice of material reuse can help an organization stand out
- Develop an internal process—materials can be recirculated inside a portfolio or a network of projects
- Measure and publicize your sustainability gains from reuse and deconstruction
- Deconstruction and building material reuse has real world impact on housing affordability and provides a foundation for workforce development programs

Beacon Hill 5-story single family home



- 18 appliances
- Kitchen garden level
- Utilized 3rd party mover



Milton kitchen



Boston Building Resources

Andrew Thompson

Interim Executive Director

andrew@bostonbuildingresources.com

339.222.9216 (mobile)

A wide-angle photograph of a city skyline, likely New York City, featuring several prominent skyscrapers and a bridge over a body of water. The sky is a clear, pale blue. In the foreground, a bridge with a white metal railing and stone pillars spans across the water. A blue rectangular box with the white text "Q&A" is centered in the middle of the image, partially obscuring the buildings behind it. The buildings vary in height and style, with some having glass facades and others being more traditional brick or stone structures. The overall scene is bright and clear, suggesting a sunny day.

Q&A

COMING SOON:

Built to Lead: Lessons in Resilience

Date & Location TBA

