RETROFITS WITH PURPOSE:

Turn net-zero ambitions into reality

55 University Avenue

Toronto, Ontario

CAGBC Canada Green Building Council

Acknowledgments

This case study has been prepared as part of the Purpose Retrofit Accelerator, funded by Natural Resources Canada's (NRCan) Deep Retrofit Accelerator Initiative (DRAI). Building decarbonization retrofit work is typically pursued in a sequence of interventions extending over a period of several years. This series will highlight projects at various stages of their retrofit journey.

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About the Project

Project type: Deep Net Zero Retrofit

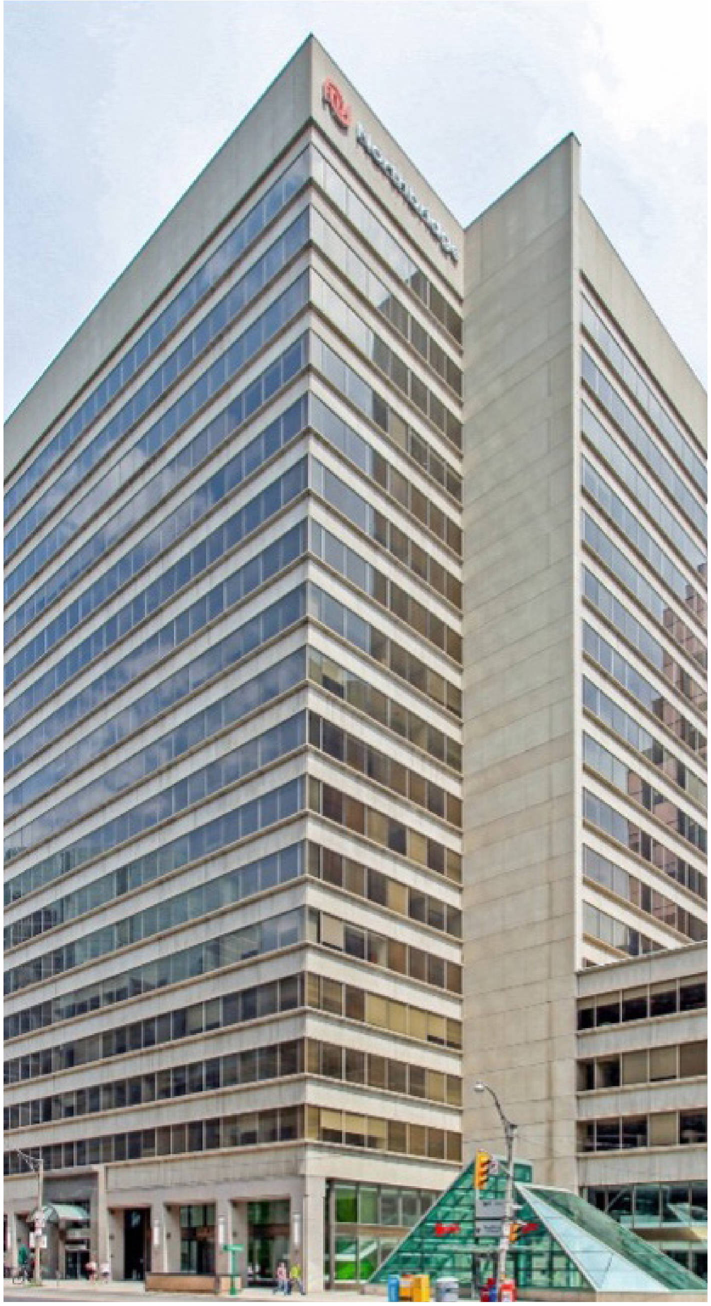
Timeline: 2022 to Present

Asset class:
Office with ground-floor retail

Gross floor area/ leasable area:
310 302 sf/ 261 576 sf

Number of floors: 19

Original construction: 1977



Project Team

Property Owner:
I.G. Investment Management Ltd., as trustee for IG Mackenzie Real Property Fund

Property Management:
BentallGreenOak (Canada) LP

Transition Planning and Owner's Representative: Purpose Building

MEP Engineer: HIDI Group

MEP Contractor: Bird Mechanical

Building Envelope Expert:
Synergy Partners

Architect: Superkül

Building Envelope Contractor: C3

Structural Consultants: Salas O'Brien (formerly Stephenson Engineering)

The Retrofit Journey

This “Retrofits with Purpose” series chronicles buildings supported by the Purpose Retrofit Accelerator at key milestones in their retrofit journey. At the time of this case study, 55 University was constructing the heating plant renewal, with other aspects completed.

Purpose identified funding sources for this retrofit work, including through the Purpose Retrofit Accelerator funded by Natural Resources Canada’s (NRCan) Deep Retrofit Accelerator Initiative (DRAI). The heating plant renewal was eligible for this funding, which can be applied to consultant fees; capital costs cannot be offset by this funding.

Deep retrofits for Canada’s buildings are vital for reducing greenhouse gas (GHG) emissions, meeting occupant needs, and preserving long-term asset value. A deep retrofit is not a single moment in time, but a journey of years. Deep retrofits can be broken down from strategic planning through to moments of intensive effort to deliver major projects — such as upgrading windows or heating systems.

Following the process developed by Purpose, and using their **portfolio screening tool**, owners of multiple buildings can focus on the buildings where intensive effort is most urgently needed.

Supporting an effective retrofit journey requires the development of a **Transition Plan**, which sets major project scope and timing to complement the building situation. This Transition Plan considers factors like building condition, occupant needs, retrofit benefits and costs, and interaction between the projects needed to complete the deep retrofit.

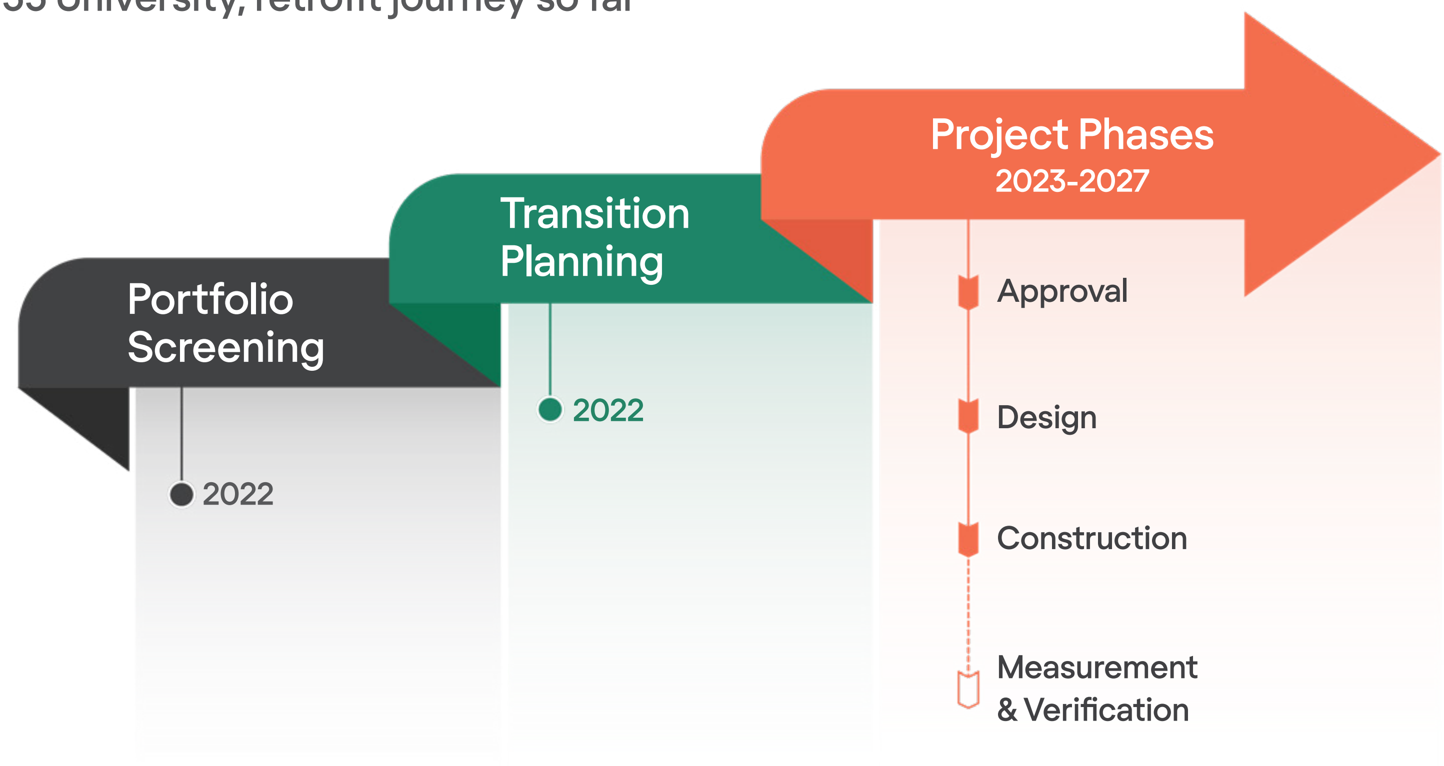
Each major project then proceeds through milestones including **Approval**, **Design**, **Construction**, and at completion the projects are validated through **Measurement and Verification (M&V)**.

55 University: A Big Picture Approach

In 2022, the office building at 55 University in Toronto faced significant renewal needs. Constructed in 1977, the building's chillers were nearing their end of life, and other issues were beginning to emerge that the owners were eager to address.

This included the aging heating boilers and exterior walls which were showing 50 years of wear, along with windows that looked scratched or foggy (due to decades of use, failed seals, and low thermal performance), with some leaking issues. Combined, these issues led to excessive energy consumption and low comfort levels. It's a situation common to older buildings, but rather than tackling each system individually, owner IG Mackenzie and property manager BentallGreenOak (BGO) took a big-picture approach, seeking a comprehensive retrofit plan that would ensure the building's operational performance and its continued desirability for current and future tenants.

55 University, retrofit journey so far



Strategic Planning: Starting Early to Enable Retrofits

Owner IG Mackenzie and property manager BentallGreenOak knew 55 University's challenge was ensuring the retrofit process started early enough to get ahead of potential issues or even failures. As the chillers neared end of life, now was the time to plan for the building's future. Consensus was that the chiller could not be trusted to last another summer, and while the windows, walls, boilers and water heaters might last another few short years, the owners knew that strategically planning and renewing these systems might use up the time left in these systems. The owners wanted to prioritize more desirable systems and have them implemented before a failure forced an emergency like-for-like replacement.

IG Mackenzie wanted to reposition the building and decarbonize to attract leasing and investment interests. BentallGreenOak believed the asset had great potential and was aligned with the strategy. Ownership and management turned to Purpose to develop a transition plan that looked at the building's challenges holistically and identified opportunities to align with upcoming building needs and future ambitions.

One critical aspect of the retrofit was maintaining and improving tenant satisfaction. Areas of attention included the envelope, which would not provide the level of comfort for the desired tenants, especially around the perimeter. Renewing the envelope could improve the building's energy and carbon performance while also bolstering tenant satisfaction and increasing the building's appeal to potential tenants — outcomes that enhanced the business case for a deep retrofit approach. IG Mackenzie also saw an opportunity to grow institutional retrofit knowledge for future projects.

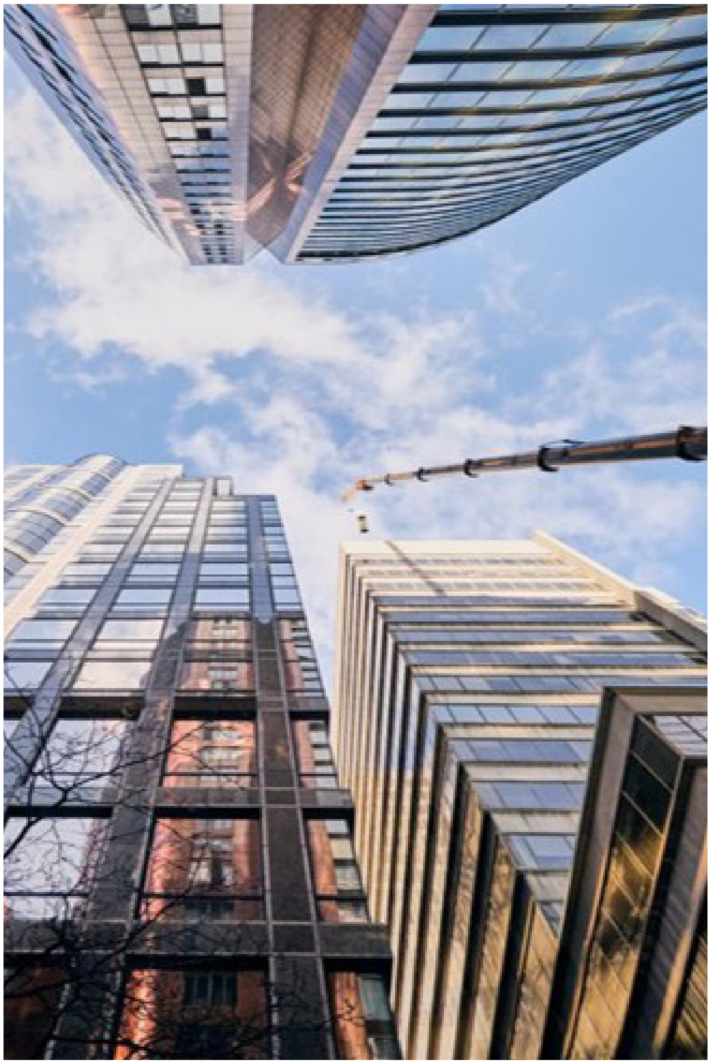
Creating the Transition Plan

Advancing on IG Mackenzie and BentallGreenOak's ambitions for the building required an investment in the right project team and ensuring a process of collaboration to deliver results. Mackenzie and BentallGreenOak engaged Purpose to bring the right project team together and coordinate their work. Other project partners included the building envelope firm Synergy and HIDI Group, a mechanical, electrical, and plumbing (MEP) engineering firm. Each organization brought years of experience to the table and a shared spirit of collaboration. By investing in an experienced project team, the retrofit proceeded to deliver on the owner's vision, while staying on schedule and on budget.

The project team developed three envelope options to present to the building owners: a like-for-like approach that would have replaced the insulated glass units (IGUs) with similar products, a high performance option with aluminum frames and triple-glazed panels, or the maximum performance option with fiberglass frames, triple-glazed panes and exterior insulation and finish systems (EIFS) over existing cladding.

The project team was initially concerned that the maximum performance option would be the only way to enable fuel switching — necessary for achieving net zero. However, as options were evaluated, they realized that the high performance option could also enable fuel switching, and the maximum performance option added an incremental cost of $7 million while offering only modest benefits over the high performance option (only a few percent additional carbon savings).

These analyses provided the owner with a compelling business case for the high-performance option which provided a carbon-effective and budget-sensible envelope retrofit strategy.



To address the aging cooling chillers and heating boilers, the project team investigated multiple options. These options included introducing heat recovery chillers (HRCs), air-sourced heat pumps (ASHPs), and electric boilers, as well as converting domestic hot water (DHW) from gas to electric.

For all elements of the project, energy savings, carbon savings, and utility cost savings were balanced against capital expenditures to develop a business case for the resulting low-carbon solution.

Project Approvals: Moving to Action

After reviewing the options, IG Mackenzie and BentalGreenOak selected the high performance option for the envelope retrofit, recognizing it would open the door to fuel switching and result in meaningful energy and carbon reductions at an attractive cost.

IG Mackenzie and BentallGreenOak had the confidence to approve the construction to proceed, seeing how the plan would achieve their desired outcomes in an effective and efficient way. For example, by fine-tuning envelope performance, the project was able to save around $7 million in capital expenses and unlock value by tripling window R-value. This choice enabled operations to reduce a 180F hot water supply system to 135F, making an affordable HRC option to enable fuel switching viable.

Replacing the existing chillers with HRCs made it possible to deliver significant combustion system emissions reductions (98%) with a small incremental cost above replacing like-for-like.

They also invested in an upgraded BAS to integrate and manage the new HVAC, delivering greater comfort for occupants in all seasons. These choices balanced significant performance gains with capital costs, showing that deep carbon retrofits can be achieved with fiscal prudence.

Given the 55 University retrofit involved multiple systems, the project team recommended the work be completed as multiple projects spread out over time. Prioritizing the most urgent needs helped focus owner discussions and minimize disruptions to the building's tenants.

Implementing retrofits this way also made it easier to manage project costs. This gave the project team more time to make informed decisions, a particularly important benefit for projects that are changing building functions instead of just replacing like-for-like.

> "With BGO and IG Mackenzie, we planned and executed a multi-year deep retrofit investment on a strategically coordinated timeline that is delivering significant long-term value with minimal disruption to building occupants."
>
> — Mike Anderson
> *Principal*
> *Purpose Building*

Building Systems Addressed:

Building Envelope Systems

Existing:

Precast concrete panels with strip windows; curtain wall double glazing (R1.9) at the first and second floors; glazed canopies with double pane glazing units.

New:

Triple pane glazing units (R-5.9) and frames, flashings

Building Heating

Existing:

3 x 3,000 MBH gas boilers.

Proposed:

4 x 100 ton heat recovery chillers, 3 x 357 kW electric boilers and 2 x 1,500 MBH natural gas boilers.

Building Cooling

Existing:

2 x 400 ton standard centrifugal chillers.

New:

4 x 100 ton modular heat recovery and 3 x 100 ton conventional chillers.

Domestic Hot Water Heating

Existing:

1,000 MBH natural gas-fired hot water heating.

Proposed:

Electric hot water heating.

Constructing Each Project in the Retrofit Journey

Project One: Chiller Replacement

Timeline: 2023-2024

The first project was the most urgent. Replacing the existing chillers, which were near their useful end-of-life, required a 40-week lead time. Advanced planning helped align the solution with the envelope strategy Purpose, Synergy and HIDI Group designed, as it would inform heating and cooling requirements, potentially reducing heating demand and costs. The project team's advanced planning also enabled them to meet construction deadlines and navigate the installation, which required careful consideration of the physical space limitations where the chillers would be located.

As operations started in the first heating season, measurement and verification enabled the project team to discover that the heat recovery chiller ran less frequently than anticipated. The issue was quickly identified as a control misconfiguration which will be easily resolved during the heating plant installation.

Project Two: Envelope Improvements

Timeline: 2023-2025

The envelope renewal was not limited to glazing units and frames. The building also required new flashings, and repainting. Because of effective planning and collaboration, the window contractor, Specialty Glazing Solutions (C3), was able to deliver and install the windows with minimum change orders. Unplanned change orders can have a significant impact on project costs and timelines, so the robust planning process reduced risks of cost overruns. An additional benefit saw the windows manufactured and installed four months ahead of schedule – a rare occurrence for the post-pandemic construction industry.

A critical aspect of success was how tenant disruption was minimized. In advance of the window work, the property manager met with the tenants to complete a walk-through of their space. They identified any furniture that would need to be repositioned while windows were removed, reinstalled, and inspected. BGO assisted tenants with packing and moving where needed, and to ensure minimal disruptions, all envelope work started at the end of the week, and windows were addressed in multi-floor groups.

The project team also worked with tenants to ensure any demising walls that needed to be rebuilt were addressed after the old windows were removed. By keeping tenants engaged and informed, and by smoothing the impact of construction, tenant feedback was positive and reflected overall satisfaction with the owner and property manager's efforts to improve the building.

Project Three: Heating Plant Renewal

Timeline: 2025-2026

The heating plant renewal was the final project. The selected heating plant design incorporated both electric and gas boilers for a hybrid fuel switching design, an approach that provides the asset with the flexibility to switch between fuel sources, providing stability for tenant utility rates.

The hybrid approach ensures that post-retrofit, the building will be capable of operating within the pre-retrofit peak electrical demand of 900kW and up to an increased 2000kW demand. With this new operating flexibility, the property can dial in significant emissions reduction while being adaptable should future utility grid collaborations allow for more emissions reductions. The domestic hot water (DHW) system was switched to electric as part of planned capital improvements in 2025 and the building management systems were upgraded in 2024-2025.

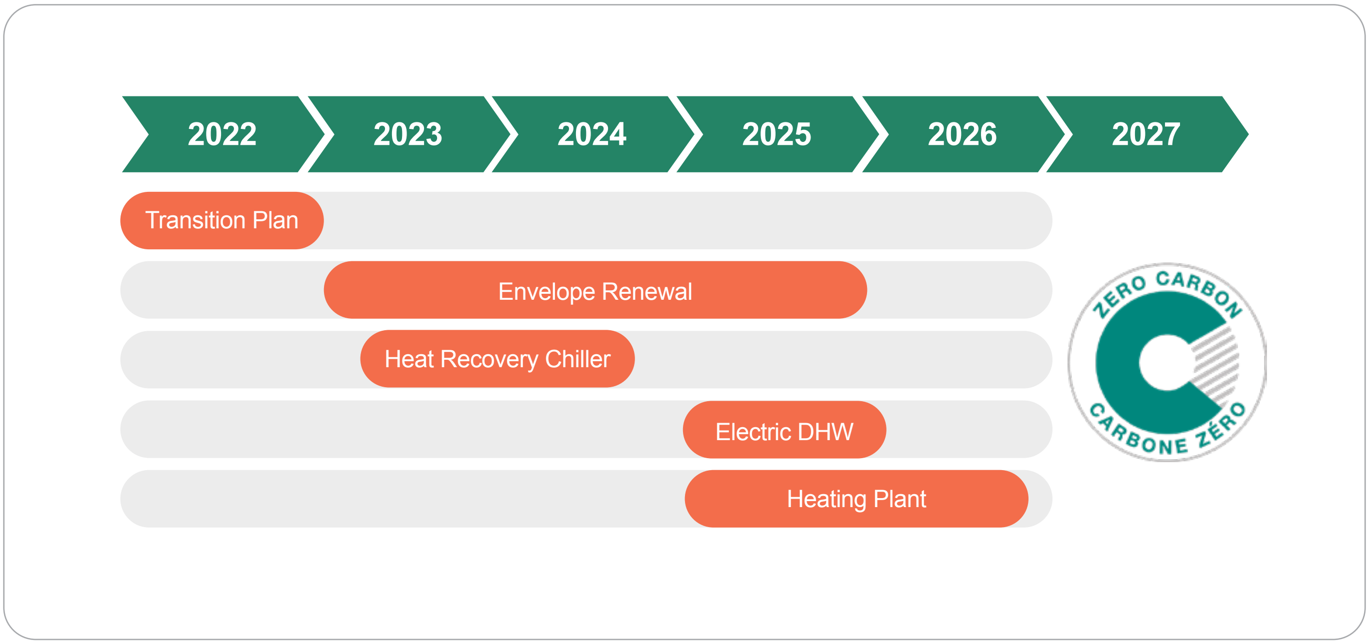
The project team only approached manufacturers who offered proven technologies and installed their equipment locally – all to avoid disruptions due to an uncertain trade environment . Under these guidelines, BentallGreenOak invited three manufacturers to present their project approach and quote – one in Canada and two in Europe – with an advance plan for transport logistics and timelines should a European company be selected.

Measure and Verify: Moving 55 to Zero

The Measurement and Verification phase of a retrofit is crucial. Building teams ensure installed systems operate effectively and compare project performance outcomes to what was targeted in the original investment business case, validating that they are aligned.

Ahead of deep retrofit implementation, 55 University had an energy use intensity (EUI) of 263 ekWh/m² and a greenhouse gas intensity of 25.6 kg CO2e/m². Through rigorous analysis, the project team anticipated that the upgrades to the heating and cooling systems, building envelope replacement, and electrification of the DHW system would result in the elimination of almost all (98%) building combustion emissions. Further, 65 percent of the building's total emissions would be addressed, with only the emissions associated with electricity from the grid remaining.

The decarbonization strategies have also streamlined the building's path to pursue certification under the Canada Green Building Council's Zero Carbon Building – Performance Standard™. The property expects to be ready to pursue ZCB-Performance certification by 2027.



> Immediately on the completion of the envelope improvements, tenants reported reduced noise intrusion from traffic, particularly on lower levels of the building. Tenants also experienced noted improvements in their comfort from a thermal perspective – no more huge temperature swings along the perimeter spaces.
>
> — Deb Beurling
> *Senior Director, Property Management*
> *BentallGreenOak*

At the time this case study was written, 55 University completed the first and second projects (chiller replacement and envelope refurbishment), while the final project (the heating plant renewal) was underway, with an anticipated completion of August 2026.

Retrofit by the Numbers

	Pre-retrofit (baseline)	Post-retrofit (predicted)
Greenhouse gas intensity (GHGi)	**2.3** $kgCO_2/ft^2$	**0.8** $kgCO_2/ft^2$
Window embodied carbon	**N/A**	**1500** $etCO_2$
Energy use intensity	**24.5** $ekWh/ft^2$	**15.01** $ekWh/ft^2$
Natural gas consumption	**24.8 kg** CO_2e/m^2	**98%** carbon reductions 0.5 kg CO_2e/m^2

Lessons Learned

The deep retrofit was designed to ensure 55 University's value and competitiveness for the future. Among the key lessons learned were:

1 **Early strategy enables better retrofits:**

Retrofits benefit from advance planning to anticipate potential system failures and ensure enough runway for renewal before costly and disruptive breakdowns occur. By planning ahead, this retrofit avoided sinking investments into status quo systems. Complex retrofits that touch multiple systems also benefit from coordination, where planning occurs before (not after) the first system might start to fail.

2 **Invest in the right project team:**

With an experienced project team invested in the owner's vision and a process of collaboration for the planning, selection and implementation of the retrofit, this project was able to was able to deliver high performance building results while saving $7 million in capital expenses. Change orders were kept to a minimum, received quotes were clear and accurate — within one to three percent on heat recovery chillers and electric boilers. As a result, work was completed on schedule with limited surprises.

3 **Big lift, not final mile:**

Targeting the big lift (98% combustion emissions reductions) and not the final mile (100%) saved millions in capital and more in operating costs, making the project possible. Paired with a 65% reduction in total building emissions, this retrofit showed significant change is possible while also ensuring the business case makes sense. The choices the owners and project team made will have long-term benefits – recovering the 1,500 tons of envelope embodied carbon within 3.5 years of operational emissions savings, and connections ready to install future systems that will increase efficiency even more.

4 **The technology you need is available:**

For 55 University, the project team prioritized manufacturers with proven track records that could install their equipment locally. While each building will have challenges, the industry is past the point of trailblazers – retrofits are happening, with readily available technology.

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