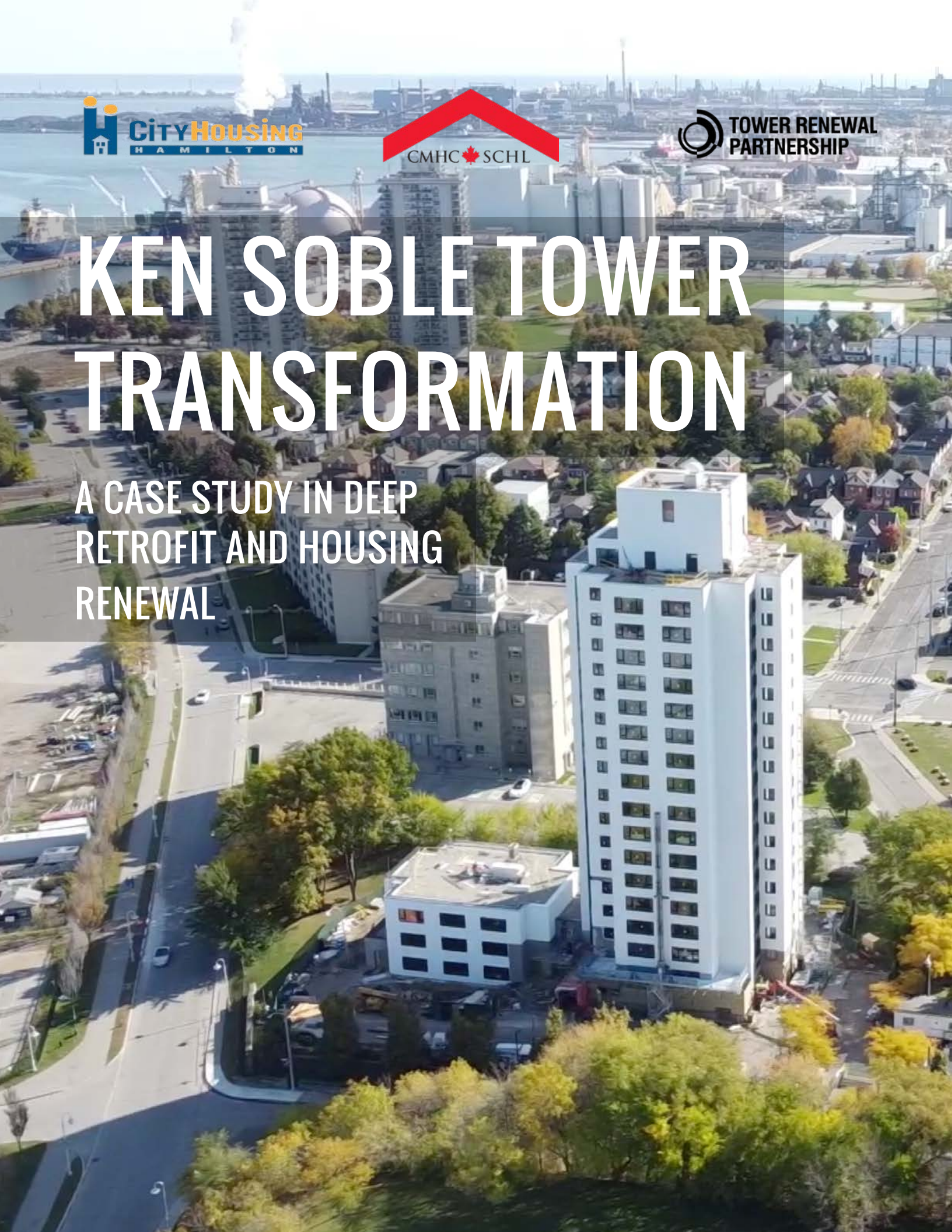


CITY HOUSING HAMILTON

CMHC SCHL

TOWER RENEWAL PARTNERSHIP

KEN SOBLE TOWER TRANSFORMATION

A CASE STUDY IN DEEP RETROFIT AND HOUSING RENEWAL

ABOUT THE TOWER RENEWAL PARTNERSHIP

Tower Renewal is a model to transform Canada's remarkable stock of postwar apartment towers and their surrounding neighbourhoods into more complete communities, resilient and healthy places, fully integrated into their growing cities. Led by the Centre for Urban Growth + Renewal and supported by a group of core partners, the Tower Renewal Partnership is a collaborative initiative working to preserve and enhance this key housing through research, advocacy and demonstration projects. The Tower Renewal Partnership's goal is to enable reinvestment into these dynamic neighbourhoods, working toward building lower-carbon, healthier and more complete communities.

ABOUT CITYHOUSING HAMILTON CORPORATION

City Housing Hamilton Corporation (CHHC) commenced operations in 2006. Its mandate is to provide affordable housing that is safe, well maintained, cost effective and that supports the diverse needs of Hamilton's many communities. CityHousing Hamilton provides housing to families, seniors, couples, single people, and people with special needs in a variety of housing forms including townhouses, apartments, single and semi-detached dwellings. Most of the housing is available on a rent-geared-to-income basis, however some projects offer market rent units as well. CityHousing Hamilton is more than just bricks and mortar. In partnership with community agencies, a variety of support programs are offered for our residents and the broader community.

CMHC SCHL

This work was made possible with the generous support of the Canada Mortgage and Housing Corporation

TOWER RENEWAL PARTNERSHIP

TABLE OF CONTENTS

01. CONTEXT

Most apartment towers in Canada were constructed between the mid-1960s through the mid-1980s. These towers provide a considerable percentage of the existing affordable purpose-built rental housing in Canada. In the postwar years, supported by federal policy and incentives, hundreds of thousands of units of privately-owned apartments were built across the country for a rapidly growing population. However, they were constructed with little regard to energy efficiency, resiliency, and adaptability. Though they continue to provide affordable homes to millions of Canadians, this obsolescence represents a growing liability due to the relatively poor condition and performance of the stock. Its poor condition also represents a risk of the loss of affordable housing units, as owners contemplate whether or not to reinvest or sell their properties for other purposes. Another renewal pressure can be found in the fact that given shifts in demographics, buildings constructed to meet past needs (e.g.; families) may not be appropriate to meet current needs (e.g.; singles and seniors).

While there is an increasing urgency for owners to reinvest in their buildings, the scope, complexity, disruption, and cost of renewal projects can deter investments to modernize. As a result, there is a lack of practical experience and guidance on how to renew rental towers in a way that balances costs with benefits, prevents a loss of affordable dwelling units, and ensures that the net operating income of owners is not negatively impacted. To fill this data and information gap, the City of Toronto initiated the “Mayor’s Tower Renewal” project to demonstrate practical approaches for renewals and to develop guidelines which were released by the University of Toronto in 2009. The guidelines looked beyond traditional energy efficiency retrofits to include improvements that would result in deep energy savings and emission reductions, while improving the value of each building, such as façade re-cladding, updating equipment, systems and the layout of apartments, and redeveloping the space around the base of the buildings if possible. They also targeted social, environmental, and economic dimensions targeting tenant engagement, green jobs, enhanced energy efficiency, durability, liveability, services, and amenities. However, since that time, a very limited number of buildings have been fully renewed to the condition and performance standard championed by the guideline’s authors. As a result, the full costs and benefits of a comprehensive tower renewal have yet to be documented and studied. In order for owners of apartment towers to make informed decisions on how to reinvest in their buildings, a strong evidence base is required to document the impacts from social, environmental, and economic perspectives.

In 2018, CityHousing Hamilton Corporation, the public housing arm of the City of Hamilton applied for funding under the Affordable Housing Innovation Fund (AHIF) for the renewal of the Ken Soble Tower. Built in the 1960s, the tower has since fallen into a state of disrepair, with declining occupancy, and increasing capital repair costs. An investment in the tower by AHIF and other sources would allow the building to be renewed including achieving Passive House levels of energy performance (reducing energy intensity by 70% and greenhouse gas emissions by more than 90%). As of 2021 Ken Soble Tower is the largest certified residential passive house in North America. This would also include improvements to indoor air quality through the installation of efficient and effective ventilation, the use of low pollutant emitting materials and finishes, the realignment of interior spaces to provide housing for different demographics, and implementing measures to foster improved social inclusion.

02. INTRODUCTION

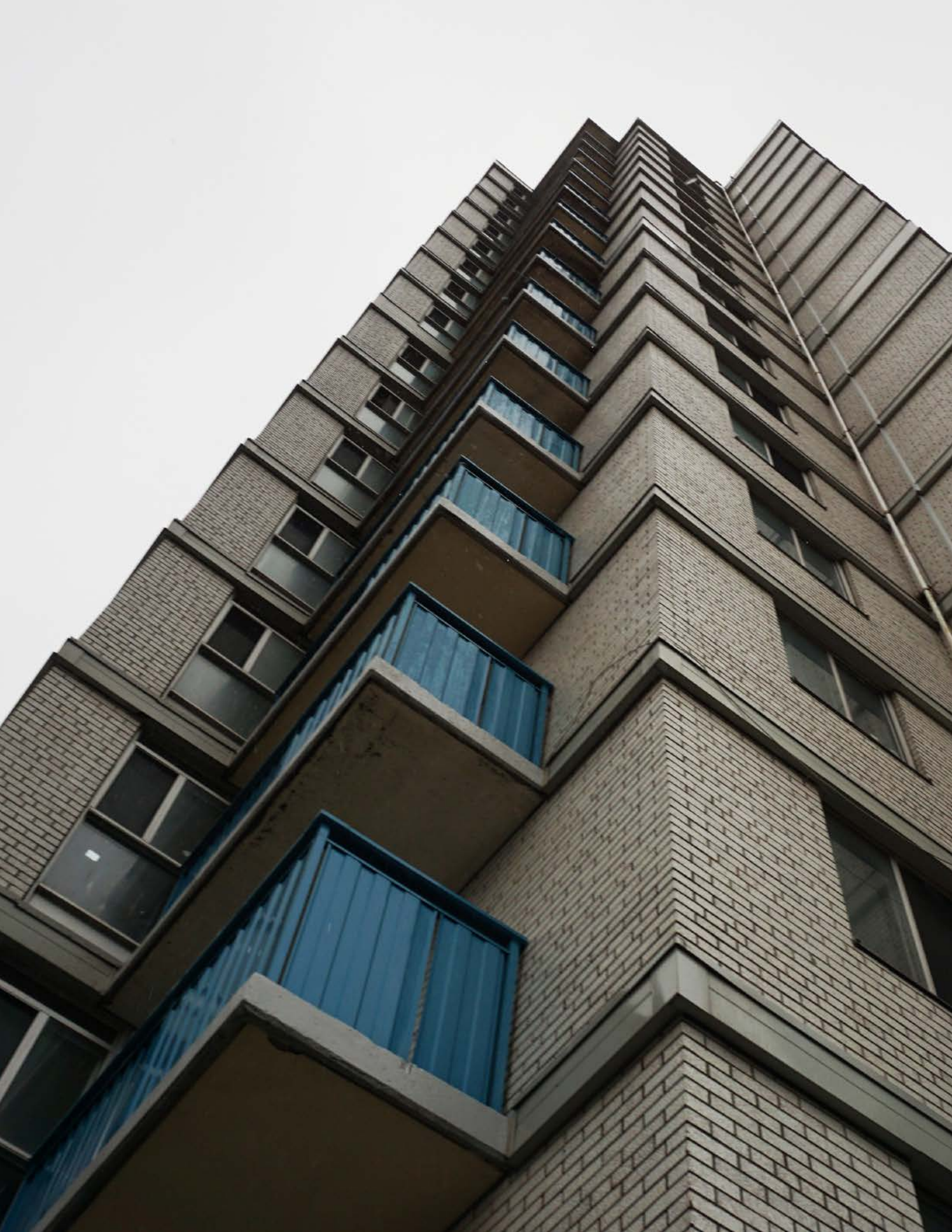
KEN SOBLE TOWER TRANSFORMATION OVERVIEW

The Ken Soble Tower Transformation will modernize 146 units of affordable seniors' housing, while reinvigorating community spaces and outdoor gathering areas, planning for aging-in-place and barrier-free living, and a changing climate. One of the first Passive House retrofits in North America, at 18 storeys and more than 80,000 sqft, the Ken Soble Tower will be one of the largest EnerPHit-certified projects in the world. Slated for completion in 2021, the project will provide residents with improved comfort and control of their indoor environments and with the ability to withstand extreme climate events into the future.

With thousands of aging postwar apartment towers across the country providing critical affordable rental housing for millions of Canadians, strategies for the preservation, modernization and low-energy retrofit of this housing stock are urgently required. The Ken Soble Tower rehabilitation can provide a piece of the crucial roadmap needed to guide future projects.

- The project will demonstrate a number of **energy retrofit solutions** that will advance industry capacity, including high-performance envelope and building system retrofits targeting more than 90% greenhouse gas emission reductions, alongside a host of co-benefits including healthy, and comfortable indoor environments.
- It will also demonstrate a set of **social sustainability outcomes**, designed for accessibility, aging-in-place, and social opportunities by focusing on an increase of up to 21% barrier-free units and improved resident and community amenity spaces.
- Finally, it will ensure the maintenance of **long-term affordability**, while demonstrating economic sustainability through reduced operating costs, with the project addressing all urgent capital repairs and replacing many aging distribution systems at once.

By 2016, the Ken Soble Tower sat 70% vacant due to disrepair and carried a significant capital deficit. With a City of Hamilton waitlist of over 6,000 households, it is urgent that this housing asset be brought back online. The Ken Soble Tower rehabilitation will reinstate 146 state-of-the-art units geared to senior citizens within a transformed building, alongside comprehensive accessibility upgrades, and community amenity upgrades. The rehabilitated building will have enhanced interior and exterior common areas, including the creation of a new penthouse community room.



PROJECT RATIONALE

The Ken Soble Tower has been in decline for several years. Anticipating forthcoming change, starting in 2012, CHHC began to develop a tenant relocation strategy in order to provide a smooth transition for residents moving into other CHHC buildings. After a study of several options, including sale, rebuild, capital repair, and rehabilitation, CHHC determined that rehabilitation is the preferred approach to revitalizing the site. In addition to being an excellent candidate for retrofit, at a much lower cost than rebuilding, the tower is a landmark in the West Harbour neighbourhood. A 2015 community engagement program found that the Ken Soble Tower is regarded as a cornerstone of the neighbourhood by both residents and the broader community. The building's transformation will allow CHHC to continue to provide affordable housing for a neighbourhood undergoing change. The tower's transformation also meets key policy objectives outlined in the City of Hamilton's Secondary Plan for West Harbour, including the provision of affordable housing, adaptive reuse of building stock, and climate change mitigation. The deep energy retrofits proposed for the Ken Soble Tower provide a number of additional benefits, including improved community resiliency, housing quality, and accessibility. Using an innovative financial model, this option was selected by CHHC, delivering the most benefit at the lowest cost, and providing a sustainable operating model while securing affordable housing in the West Harbour.

Project Drivers:

- Help fill the housing gap for low-income seniors in the West Harbour neighbourhood.
- Provide residents with improved comfort, health, and control of their indoor environments, while radically reducing the environmental footprint of the building.
- Improve social sustainability within the building through addition of communal indoor and outdoor spaces, the conversion of units to barrier-free, and through implementation of aging-in-place design principles.
- Conduct extensive repair and replacement program on aging distribution systems, envelope, and significant interior fit-out scope to reduce future capital requirements.
- Develop an innovative program of capital financing and operations to enable the transformation and sustained operations of the Ken Soble Tower.
- Lead the West Harbour revitalization, shifting the conversation from affordable housing as a liability to affordable housing as a cutting-edge landmark.
- Provide an innovative replicable model for the renewal of this pervasive building type.

Ken Soble Tower Aerial View. Source: Google Maps

TOWER RENEWAL PARTNERSHIP

PROJECTED IMPACTS

This project will reduce energy intensity by 70% and greenhouse gas emissions by over 90%. The Ken Soble Tower represents a key opportunity to demonstrate best-in-class, ultra-low energy retrofit techniques. The retrofit of the tower will meet EnerPHit Certification, a branch of the Passive House standard designed specifically for building retrofits. Passive House certification is applicable to ultra-low energy buildings, which have nearly eliminated dependence on fossil fuels for heating and cooling, while significantly reducing greenhouse gas emissions. The basis of the Passive House approach is a high performance envelope, achieving nearly twice the insulation value of building code requirements, which drastically limits heating demand. Using simple products and practices similar to traditional building methods, the Passive House standard can achieve high performance while remaining relatively low-tech. This project would qualify as one of ten of the multi-residential retrofits registered with International EnerPHit Certification in the world. **The refurbishment of this multi-unit residential tower to the Passive House standard will be the first of its kind in North America — providing a bricks and mortar demonstration for widespread dissemination.**

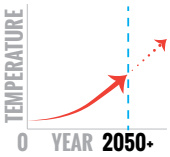
Environmental Impact

The first of its kind in North America, this project's environmental benefits will act as a model for achieving Passive House performance in existing residential towers.

- Dramatically reduced energy intensity by 70%
- Dramatically reduced greenhouse gas emissions by 90%
- Reduced resource consumption through a 45% reduction in utility costs (electricity and water)
- Improved indoor air quality contributing to resident health and comfort
- Passive resilience to extreme heat and cold or loss of power
- Low impact landscape with native plant species and bioretention cells
- Improved physical condition and extended life of the building
- Reduction of materials entering the waste stream

Economic Impact

146 units of modernized AFFORDABLE SENIORS' HOUSING



DESIGNED FOR A CHANGING CLIMATE

This project is supported by a strong business case, based on full cost accounting. Economic impacts include a financial model built on a sustainable operating budget, as well as a host of municipal-scale impacts with long-term benefits to the local economy.

- Introduction of an innovative financial model, enabling enhanced debt capacity due to lower future operating costs
- Increased revenue from tenure mix and rehabilitation of currently vacant units
- Post-construction sustainable operations
- Capital backlog addressed with most systems and distributions renewed for a 30-year outlook
- Modern housing amenity at affordable rates
- Demonstration of a sustainable financial model for other sites
- Reduced long-term public cost of emergency services for those in housing crisis

Social Impact

20% OF UNITS BARRIER FREE

This project will have impacts on health, community resiliency and quality of life. Additionally, a series of community engagements have indicated that the rehabilitation of this building will be well-supported by the neighbourhood.

- Retention and rehabilitation of a key affordable housing asset
- Investment in and reconfiguration of interior and exterior common areas to strengthen resident community, improve safety, and animate the ground floor and penthouse
- Conversion of all common areas and 21% of units to be fully barrier-free
- Improved resident health, control, and comfort
- Support of at-risk senior citizen demographic through the implementation of aging-in-place principles
- Partnerships with local nonprofit agencies to bring programming to building residents and to wider neighbourhood
- Implementation of ongoing tenant engagement and education program
- Neighbourhood stabilization and resilience

TOWER RENEWAL PARTNERSHIP

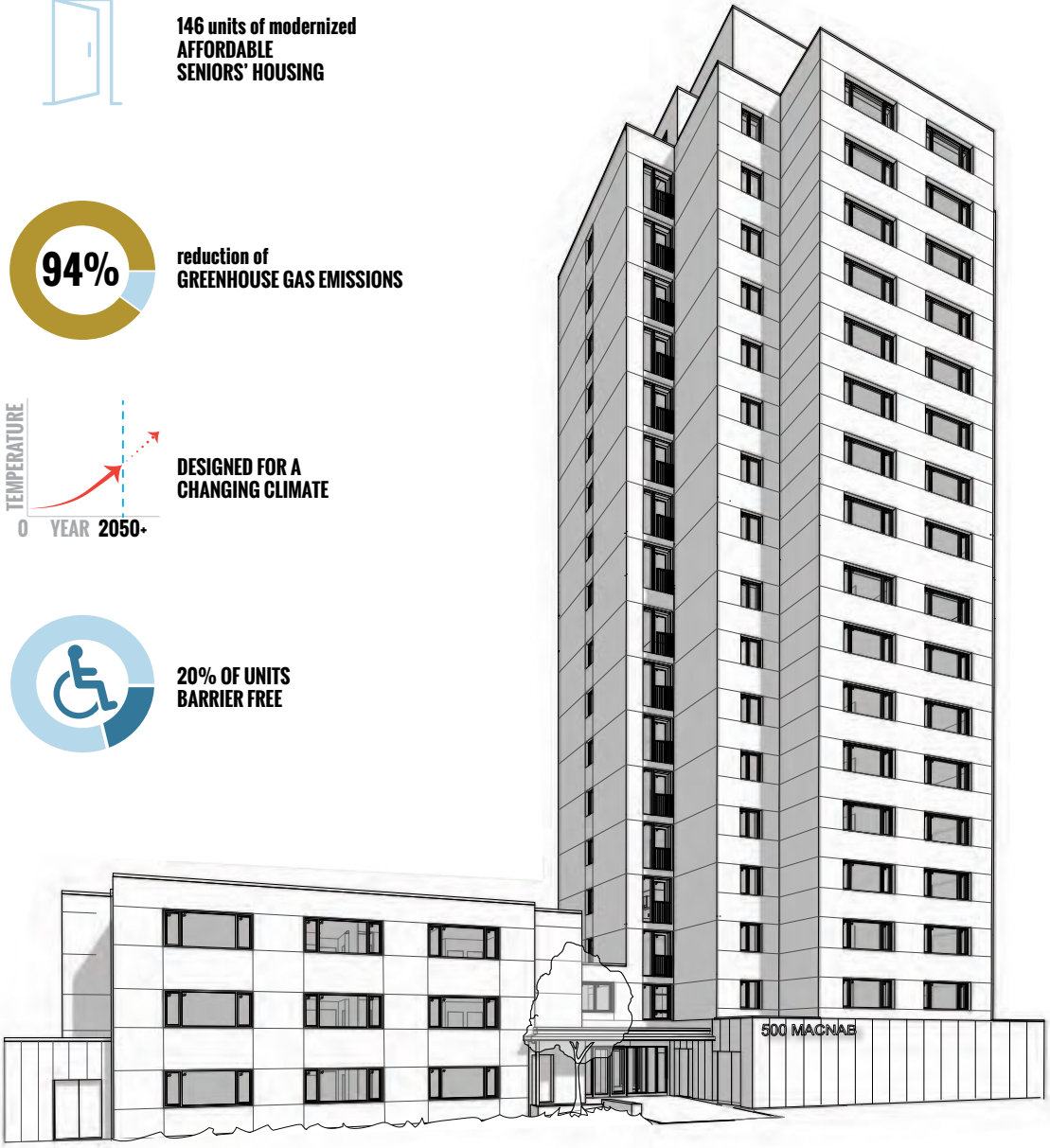
146 units of modernized
AFFORDABLE
SENIORS' HOUSING

94%

reduction of
GREENHOUSE GAS EMISSIONS

DESIGNED FOR A
CHANGING CLIMATE

20% OF UNITS
BARRIER FREE



03. BACKGROUND CONTEXT

PROPERTY DESCRIPTION & CURRENT CONTEXT

The Ken Soble Tower is an 18-storey apartment tower with an adjoining three-storey walk-up. The property is located at 500 MacNab Street North, and is a landmark within Hamilton's West Harbour neighbourhood. Constructed in 1967, the Ken Soble Tower was a showcase project for Hamilton's Urban Renewal movement during the 1960s, providing 146 affordable housing units for singles and seniors.

The Ken Soble Tower has historically been in high demand, offering housing for singles and seniors in a downtown location which provides easy access to vital social services. The building contains bachelor and one bedroom apartments in addition to programmed community space on the ground floor. The building was fully occupied until 2014, when vacancy began to grow due to a number of social issues and aging infrastructure. With a growing vacancy rate, the backlog of capital repairs, and the forthcoming West Harbour neighbourhood transformation, City Housing Hamilton and the City of Hamilton began discussions about the future of this building.

In 2016, Deloitte LLP undertook a West Harbour Affordable Housing and Transition Strategy report to provide CityHousing Hamilton and Hamilton City Council with data to inform the decision-making process regarding the future of 500 MacNab Street North. Following a review of four options, including Sale, Rebuild, Capital Repair, and Refurbishment, the report found Refurbishment to be the optimal approach from both an affordability and sustainability perspective.

Through a series of secured loans and grants, CityHousing Hamilton is able to undertake a Passive House-level retrofit paired with an innovative program of capital financing and operations to enable the transformation and sustained operations of the tower.

A 2015 community engagement program found that the Ken Soble Tower is regarded as a cornerstone of the neighbourhood by both residents and the broader community, despite its poor physical condition and a history of social challenges. The 2015 program found that there is growing excitement for the building's renewal with the majority of previous tenants eagerly waiting to move back into the building.

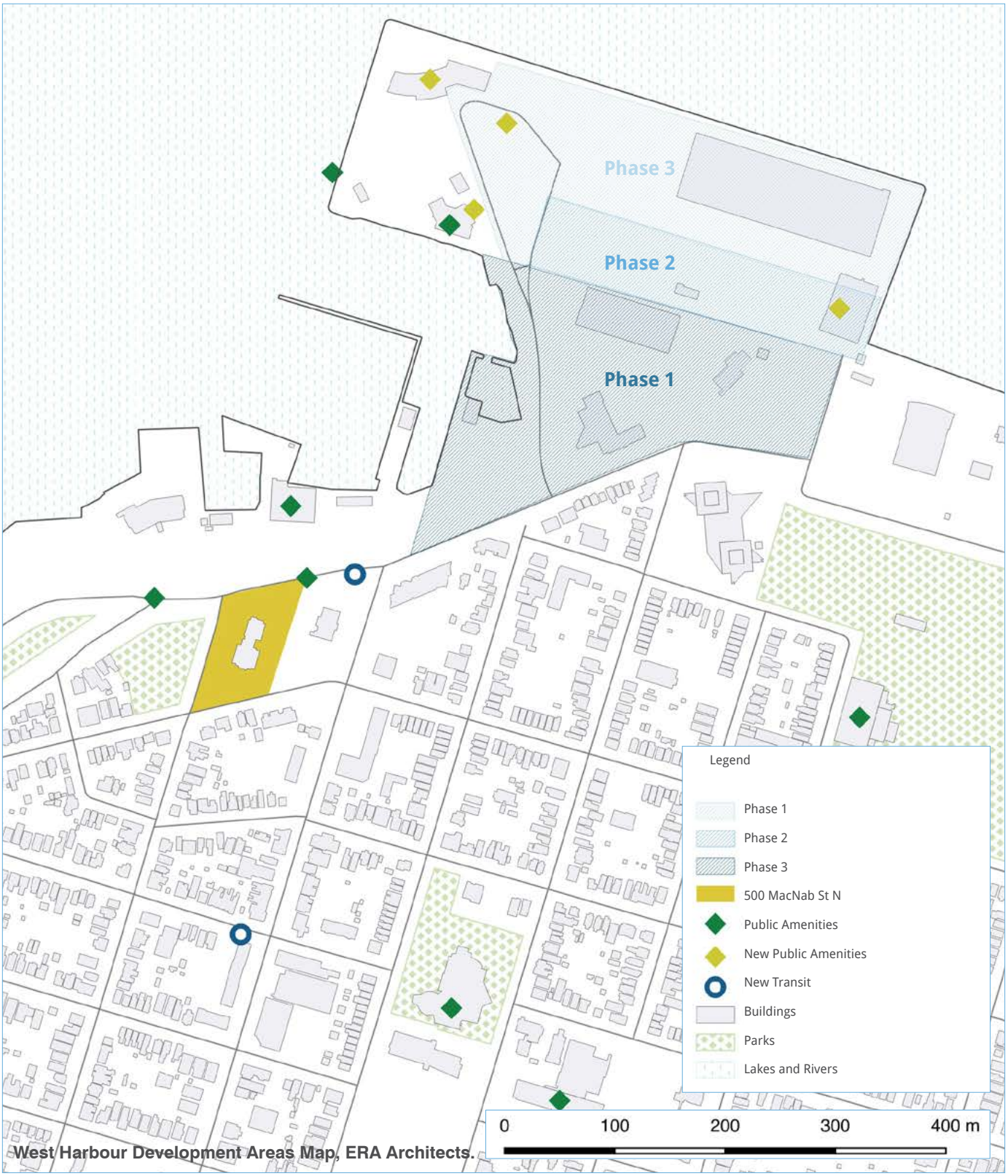
NEIGHBOURHOOD CONTEXT

The Ken Soble Tower is located in Hamilton's North End Neighbourhood on the west side of the Hamilton Harbour. The North End is one of the oldest neighbourhoods in the city, with its development beginning in the early 1800s. Historically, it was one of the first industrial areas within the City of Hamilton, due to its proximity to the water. Today, it is primarily a residential neighbourhood made up of low-density single family homes and several high density apartment buildings. The Harbour Shoreline extends throughout the neighbourhood, a large portion of which is used as active industrial areas for shipping and recreational boating. The West Harbour neighbourhood is now on the cusp of a major transformation: the City of Hamilton has launched a regeneration program to transform the area from a former industrial port to a vibrant waterfront community, made up of mixed-housing, new parks, residences, businesses, shops, community uses and services.

The City of Hamilton Secondary Plan for the West Harbour describes a vision of a future mixed-use, affordable, and energy-efficient neighbourhood. But as redevelopment plans draw significant investment, vulnerable populations living in affordable housing in this neighbourhood are at risk of displacement. By maintaining affordable, sustainable housing within a rapidly-gentrifying neighbourhood, the rehabilitation of the Ken Soble Tower is pivotal to achieving these municipal objectives.

Pier 7 and 8 Urban Design Study: City of Hamilton. 2016

Source: Pier 7 and 8 Urban Design Study: City of Hamilton. 2016



West Harbour Development Areas Map, ERA Architects.

HISTORICAL CONTEXT

As part of Canada's urban renewal program between 1954-1970, Hamilton initiated an Urban Renewal Committee to address the messy urbanism that had evolved in the old downtown neighbourhoods and create a cure-all for the city's growing urban issues. The Committee was chaired by Kenneth Soble, a well-known housing advocate and local broadcaster for CHCH. The Committee, under Kenneth Soble's leadership created a redevelopment plan that involved demolishing more than five hundred buildings deemed to not meet the required health and safety standards. These would be replaced by new homes, additional green space, and along much of the water's edge, office buildings and high-rise dwellings.

The Ken Soble Tower was constructed in 1967 as part of Hamilton's North End Renewal scheme. The scheme focused on improving living standards through modern apartment tower blocks with updated accommodations.

Prior to the North End's Renewal, the area was a well-defined, mid-nineteenth century, working class neighbourhood, housing many of the local industrial workers. A real harbor town with fishing boats and docks, and kids swimming in among all the commercial activity. This tight-knit community was renowned for its character and cohesion, but urban renewal enthusiasts could only see a blighted area in need of some clearance, more open space, a new highway, and rehabilitation. This renewal plan was set in place to bring people from the suburbs back to the city by clearing the downtown to make way for a dynamic shift, with improvements in urban structure, housing quality, roads, and institutions.

This area was prioritized for its proximity to the waterfront making it an ideal focus for clearance. The recreational development of the shoreline was a key element of the renewal and modernist planning vision. The waterfront area was planned to provide public housing for seniors and families. A density of 20 units per acre would be used, with an exception to the senior citizens' complex, which would include 146 units.

Federal, provincial, and municipal governments spent $400,000 to purchase homes and clear the land to make way for the North End neighbourhood renewal and Ken Soble development.

Decades after the renewal, the North End of Hamilton remains a cohesive, tight-knit community. Recent engagement with the local community has identified the conservation and renewal of the Ken Soble Tower as a community priority, illustrating the significant neighbourhood pride and appreciation that still exists for the building.

Ken Soble Tower, 1967. Source: City of Hamilton Archives

04. BUILDING CONDITION PRE-RENEWAL

PHYSICAL CONDITION

Pre-Renewal Building Description

Built in 1967, the Ken Soble Tower is an 18 storey apartment tower with an adjoining 3 storey walk up; together they contain 146 units. The property has a gross floor area of 81,000 sq. ft. The area surrounding the tower consists of green space along the eastern portion of the property consisting of lawn, trees, and a small community garden plot. Along MacNab Street on the west side there is a 24 space parking lot. The building is composed of poured in-place concrete, a white glazed-brick envelope and masonry back-up wall, and a modified bitumen flat roof. The mechanical systems consist of hydronic heating, a central gas fired boiler plant, and centralized ventilation delivered to the corridors.

Each floor contains eight units with a combination of one-bedroom and bachelor units.. Each unit has basic amenities including: fridge, stove, oven, balcony, heat, hydro, hot water, and domestic water. The ground floor contains offices and a large community space.. Located on the 18th floor of the main tower there is a small laundry facility which offers an impressive view of the city and harbour.

Physical Condition Overview

While the building's structure was generally sound, in its previous state, it was a growing liability due to a substantial repair backlog. Key building elements were beyond the end of their normal service life. Opposite is a table which summarizes some of the most crucial issues related to the building's pre-renewal condition. This list was been compiled based on a 2016 Building Condition Assessment along with a 2019 Pre-Renewal Audit undertaken by ERA Architects.

Building Condition Summary

Category:	Conditions:	Impacts:
Major Building System Repairs	• Frequent elevator maintenance • Frequent generator repairs • End of life HVAC plants and distribution • End of life plumbing distribution • Leaking hydronic heating system • Low-performance envelope	• Excessive energy and resource consumption • Pervasive mould • Damage to finishes • Frequent elevator and generator outages • Lack of accessibility and frustration • Health and safety concerns • Leaky windows leading to condensation and mould
Infestations	• Bed bugs • Cockroaches • Rodents	• Health and safety concerns • High volume of relocation requests • Damage to finishes • Impact on shared/community spaces and programming
Temperature Control	• Extreme heat • Extreme cold • Hydro and utilities not metred	• Health and comfort concerns • Excessive energy and resource consumption • Heavy reliance on tenant-installed air conditioners • Heating system at maximum capacity eight months out of the year • High operating costs
Balconies	• Hoarding • Pigeons	• Health and safety concerns due to hazardous material • Damage to building
Accessibility	• Broken elevators • Lack of accessible and aging in place features	• Health and safety concerns • Tenant frustration
Interior Fit Out & Finishes	• Aging kitchen and washrooms • Infestations • Mould • Peeling paint and plaster • Water damage	• Health and safety concerns • Tenant frustration • High repair and maintenance costs

OPERATIONAL CHARACTERISTICS PRE-RENEWAL

Property Management Approach

CityHousing Hamilton is a Housing Corporation which is owned and operated by the City of Hamilton. As of 2006, Hamilton Housing Corporation, Dundas Valley Non-Profit Housing Corporation, and the Municipal Non-Profit (Hamilton) Corporation were amalgamated into CityHousing Hamilton (CHH) Corporation.

CHH consists of almost 7,000 units spread over 1,265 properties with over 13,000 residents. CityHousing Hamilton is now the 3rd largest municipally controlled housing provider in Ontario. These units represent an estimated asset value of approximately $350 million and a total replacement value of $500 million. The annual operating budget for CityHousing Hamilton is $45 million. With 121 full time professional staff, the City of Hamilton's Housing Division manages Cityhousing Hamilton. Property management services are provided by in-house staff.

The 500 MacNab property management and maintenance team work on the ground to address all aspects of building operations. They provide information to new tenants, address maintenance issues, social issues, complaints, and questions. Staff are deeply engaged in the tenant experience and were able to provide insight into the depth of the repair backlog and social issues pre-renewal. Since 2016, no full-time property manager has been located on site at 500 MacNab.

Occupancy

Prior to 2014, the Ken Soble Tower was fully occupied and had a consistently long waitlist. Though aging, the building was well maintained and had local partnerships such as The Good Shepherd who programmed the shared space on the ground floor. In 2014, due to growing social and maintenance issues within the building, many tenants vacated the building. Between 2012 to 2016 the occupancy dropped from 93% to 32% (see table 2).The building contains both bachelor and one bedroom units. The average rent per unit was approximately $570 per month with tenants paying a portion of the rent through RGI (Rent Geared to Income) and subsidies covering the remainder.

Table 2: Occupancy rate between 2012-2016	
2012	93% occupied (11 vacancies)
2013	89% occupied (16 vacancies)
2014	56% occupied (63 vacancies)
2015	47% occupied (78 vacancies)
2016	32% occupied (100 vacancies)

Income and Operating Expenses

For the past decade, the Ken Soble Tower has been operating under a significant capital deficit. The ongoing capital deficit is a result of shrinking occupancy rates resulting in revenue losses, in addition to increasing operating costs due to growing repair and maintenance issues. According to the Building Operating Expense Summaries between 2012 - 2015 the 'vacancy loss' increased from 16K to over 100K. The rent revenue model, which was 100% RGI, was not providing for enough cash flow to support building operations. Further, despite the growing vacancy rates, utility bills remained consistent due to a lack of metering and leaking or inefficient systems. This model did not allow for sustainable building operations going forward.

Pre-Renewal Conditions: Unit Living Room (Above) and Bathroom (Below)

Pre-Renewal Energy Performance and Use	
Exterior Insulation	0.15 W/(m^2K) R38
Windows Max Heat Transfer Coefficient	0.85 W/(m^2K) R6.7
Ventilation Min. Heat Recovery Rate	75%
Air Tightness at 50Pa	1ACH
Annual Heating Load	25 kWh/m^2yr or 10 W/m^2 Peak
Annual Cooling Load	15 kWh/m^2yr or 10 W/m Peak
Energy Intensity	120 kWh/m^2yr
Greenhouse Gas Emissions	40 tonnes/yr

05. CONSULTATION SUMMARY

CITYHOUSING HAMILTON TENANT CONSULTATION

As part of CHH's decision to rehabilitate the Ken Soble Tower, a community engagement strategy was developed to clearly communicate with both residents and the surrounding community about the building's future. Throughout 2016, CHH reached out to residents through telephone interviews and door-to-door surveys in order to gauge what people thought about the building's rehabilitation, as well as information about relocation preferences and housing needs. The response rate was 83%, and results indicated strong support for the rehabilitation of this building. The survey information gathered shaped the discussions and focus of the engagement meetings. The community meetings provided information about important next steps for CHH. This included the need to develop transition plans for residents during renovations. Residents will be encouraged to continue participating in the process, with a select few sitting on the planning committee. CHH will continue to run engagement programs in order to capture feedback and opinions about the rehabilitation project as it is developed.

PROPERTY MANAGER ENGAGEMENT

The pre-renewal property manager was in charge of all day-to-day operations at Ken Soble including move in and outs, managing social issues, ensuring maintenance issues were addressed, dealing with complaints and liaising with the CHH board. Originally, there was a full time maintenance worker dedicated to the building but over time it was reduced to two days per week. Units were typically renovated at turnover.

Prior to the retrofit project, the building faced many challenges. Suffering from chronic bed bug infestation, a bed bug treatment program was established that included creating hotel suites on the 16th floor where they could temporarily move tenants and treat an entire floor for bedbugs. Despite the program, bedbugs persisted.

Another challenge for building management was social cohesion, with issues around gun violence, drug use, safety and the availability of social services, eventually contributing to increasing vacancy. At one point, the organization Good Shepherd had an office and 24-hour support staff working with tenants at 500 MacNab. It later moved, leaving many tenants without immediate support, contributing to the increasing vacancy.

The Property Manager listed primary tenant complaints as pests (bedbugs, pigeon feces on balconies, etc.), leaking and old pipes (impacting heating of units) and elevator breakdown as the most frequent types of issues. Likewise, she suggests the heating system and leaks in the boiler room as the most considerable inefficiency in the building in terms of energy consumption. Compounding these inefficiencies, the Property Manager noted the lack of tenant participation in energy saving measures because they did not pay hydro or utility costs. This included running heat with open windows, not notifying management of plumbing issues (running toilets or sinks) and the use of tenant's poorly installed in-suite air conditioning units.

Importantly, tenants made use of communal spaces including gardening plots behind the building and a community room (used as a community kitchen when Good Shepherd was in the building). When the community room became infested with bed bugs and was no longer usable, critical communal space was lost.

A constant list of capital repair backlog included the generator, elevator, boilers, the plumbing system. Generally, the CHH did not have the financial resources to replace these items. Nevertheless, tenants were very reluctant to vacate the building with the renewal approaching and most tenants are very intent on returning.

RELOCATION & TENANT RELATIONS ENGAGEMENT

Beginning in 2012, CHHC began to develop a tenant relocation strategy in order to provide a smooth transition for residents moving into other CHHC buildings. With many tenants having lived in the Ken Soble tower for long periods of time (the majority of tenants over 5 years), communication around the retrofit project was critical, particularly because all tenants needed to be relocated during the construction. Prior to the retrofit project, many community meetings were held at 500 MacNab that invited all residents and included senior CHH management and the local city councillor. Meeting minutes where mailed to all tenants. Further, one-on-one interviews and door-to-door surveys were conducted with all tenants to discuss their feelings towards the building, the retrofit, their needs for move out and their possible return.

Tenants were either moved to other CHH buildings or, if they were being served by Good Shepherd, they were rehoused within Good Shepherd's program to maintain on-site support. Seniors (over 60 years old) have the choice between several other apartments buildings throughout the region. However, those under 60 had only one choice - the CHH building at Hess St. and Jackson St, downtown Hamilton.

During the engagement prior to the retrofit project, most tenants welcomed the upgrades but where apprehensive about moving. Tenants were happy to hear that the bedbug and pest infestations would be dealt with and that the community room and potentially more communal space would be usable again. Nevertheless, some tenants expressed cynicism about the renewal, given the years of neglect of the building.

Since CHH has chosen to make the renewed Ken Soble tower a seniors only building, some existing tenants will not be able to return. Understably these tenants were not happy about leaving, as many feel connected and established within the neighbourhood.

Senior tenants returning to the building will need additional storage space for scooters, including the ability to charge electric scooters, more accessible elevators, common spaces and in-suite washrooms.

TENANT COMPLAINTS AND WORK ORDER SUMMARY

Since all former tenants of 500 MacNab have now been relocated, it was not possible to interview them for this study. Instead, 2627 work orders logged at the property between 2014-2019 were analysed and categorized to confirm the most dominant tenant concerns throughout this period of time.

Table 5: Tenant Complaints and Work Order Summary

Unit / Tenant Issues	**Work Order Instances**
Pest Infestation	1102
Repairs, Leaks, and Damages	471
Tenant Relocation Requests	90
Total	1663
Total Work Orders	2627
Remaining Uncategorized Work Orders	964

Investigation into the conditions at 500 MacNab reveal that a minimum of 41.9% of all work orders between 2014-2019 were in response to pest infestation. Work orders illustrated a minimum of 63.3% of building issues were related to unsatisfactory unit conditions including pest infestation, damages, and tenant relocation requests. The remaining uncategorized work orders include miscellaneous items ranging from broken locks to biohazardous waste clean up, and recaulking of windows to repair of entry doors after police-related forced entries.

06. RENEWAL PLAN

RENEWAL OBJECTIVES

At the outset of design, a project charter was established which outlined the renewal objectives set by CityHousing Hamilton. This charter formed a guidepost which was consulted at all major milestones, allowing the design team and the owner to ensure that the key targets were being met as the design evolved. The charter's measurable and achievable targets kept the project on track and all parties aligned around a central vision.

a. Bring Residential Units Back Online

The building's rehabilitation was set to modernize 146 units of high-quality affordable seniors' housing, while reinvigorating the social spaces of the building. Those 146 units, currently standing empty due to building deterioration, were to be brought back online.

b. Secure Ultra-low Carbon EnerPHit Certification

As a way of meeting both low-carbon and healthy housing targets, the project was to be certified by a third-party as an EnerPHit project. EnerPHit is the Passive House standard for retrofits, a rigorous European certification for net-zero-ready construction which focuses on occupant health and comfort. EnerPHit buildings consume six times less energy than an Ontario Building Code reference building, and have strict standards for interior thermal and acoustic comfort of occupants. The project team also challenged itself to design the retrofit for a changing climate, using 2050 temperature projections to test thermal comfort into the future.

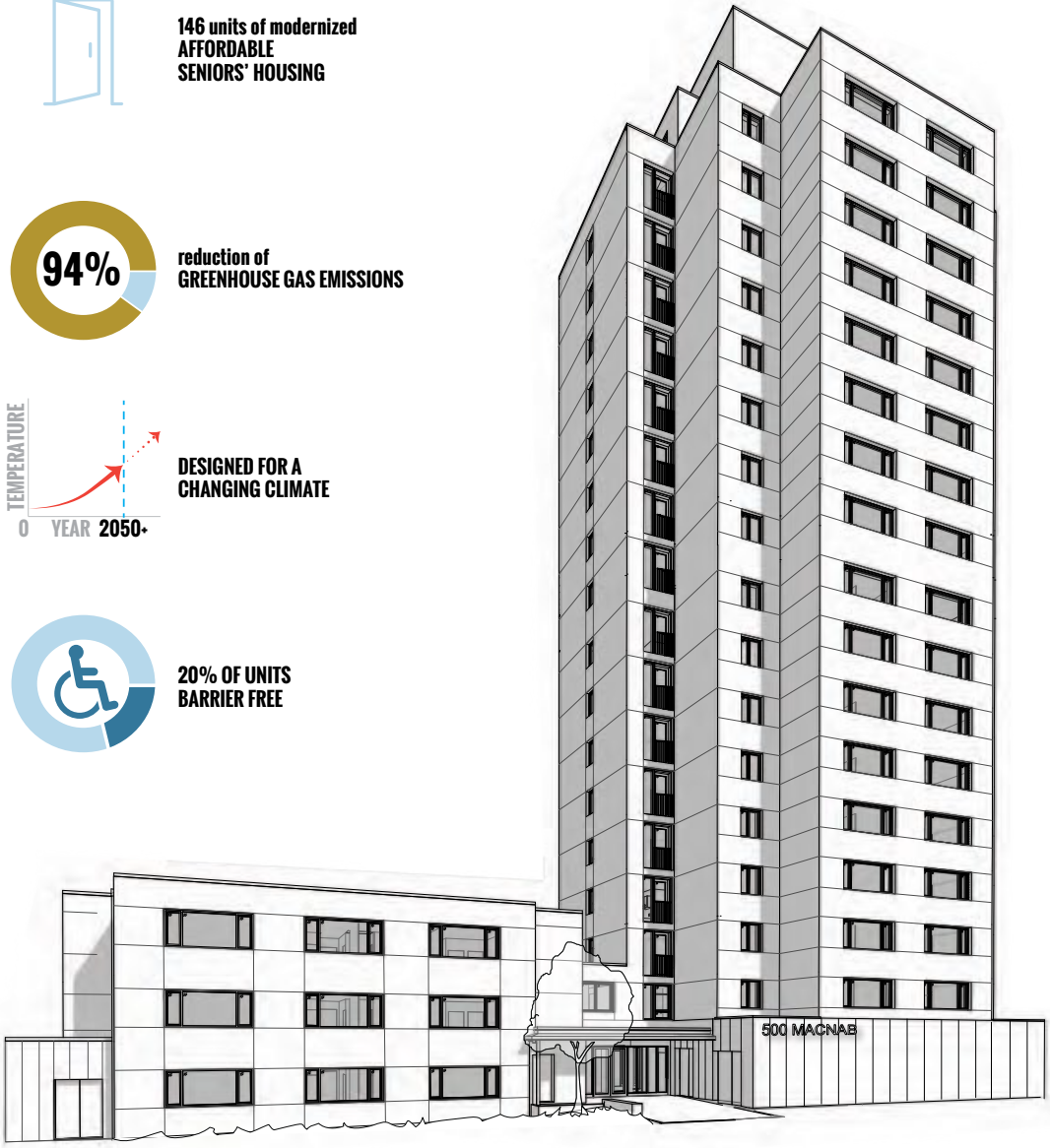
Passive House Metrics		
Statistic	**Pre-Renewal**	**Post-Renewal**
Annual heating energy per sqm	250 kWh	24.9 kWh
Annual cooling energy per sqm	none	1.9 kWh
Annual primary energy per sqm	650 kWh	130 kWh
Air tightness	5.41 ACH @ 50Pa	0.6 ACH @ 50Pa

146 units of modernized
AFFORDABLE
SENIORS' HOUSING

reduction of
GREENHOUSE GAS EMISSIONS

DESIGNED FOR A
CHANGING CLIMATE

20% OF UNITS
BARRIER FREE



SYSTEMS

Centralized HVAC with Cooling
Riser Replacements for Most Systems
Full Building Sprinklering

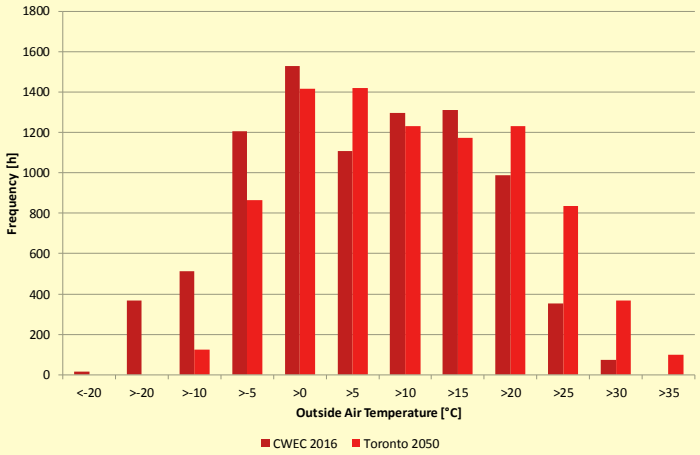
ENVELOPE

R38 Effective Overcladding
Passive House Windows
0.6ACH @ 50Pa Airtightness

MODERNIZATION

Accessibility Upgrades
New Community Room and Solarium
Interior Upgrades to Support Aging-in-Place
Rain Gardens and Green Gathering Spaces

Comfort and Future Climate Modelling



Tmean_2016 = 8.3 °C → Tmean_2050 = 13.0 °C

Projected future climate data was used to evaluate comfort at Ken Soble

	slightly cool	comfortable	slightly warm	warm
	-1.5>PMV>-0.5	-0.5>PMV>0.5	0.5>PMV>1.5	1.5>PMV>2.5
VAR2B g34 CWEC Hamilton	0	8760	0	0
VAR2B g36 CWEC Hamilton	0	8760	0	0
VAR2B g40 CWEC Hamilton	0	8759	1	0
VAR2B g34 Toronto 2050	0	8488	272	0
VAR2B g36 Toronto 2050	0	8420	340	0
VAR2B g40 Toronto 2050	0	8333	427	0

Comfort evaluations based on Predicted Mean Vote in relation to climate projections

c. Make the Tower Accessible and Supportive of Aging in Place

20% of the tower, or 31 units, were targeted to be converted to be barrier-free, and all common areas, outdoor gathering spaces, and circulation routes will be accessible and designed for aging in place. Reinvestments in indoor and outdoor common areas would be designed to support community cohesion through welcoming gathering spaces.

d. Address 30-Year Capital Repair Horizon

The design charter required that all capital repair items within a 30-year time horizon would be addressed. This would mean that all aging systems and distributions in the building would require replacement, including the modernization of ineffective ventilation systems and the replacement of aging mechanical, plumbing, and electrical distribution systems. The project would also modernize elevators and repair deteriorated underground drainage. The team was also tasked with addressing the conditions which had led to bed bugs in the pre-retrofit building.

e. Maintain Deep Affordability

CityHousing Hamilton's mandate is to provide deeply affordable housing to its clients, which was historically provided through a Rent Geared to Income subsidy at the Ken Soble Tower. Post-retrofit, that model was to be converted to a Rent Supplement model which provides the same level of affordability to CityHousing Hamilton clients that the previous RGI model had, while allowing for more sustainable long-term operations.

Visualization of front entryway

DESIGN METHODOLOGY

a. Team structure

The design execution required a collaborative and integrated approach. CityHousing Hamilton secured an experienced Project Manager from the City of Hamilton, and a design team specialized in apartment tower retrofits was assembled.

- Architectural Prime Consultant - ERA Architects
- Mechanical Engineers - Reinbold Engineering Group
- Electrical Engineers - Nemetz (S/A) & Associates
- Structural Engineers - Entuitive Corporation
- Building Envelope Engineers - Entuitive Corporation
- Passive House Designer - JMV Consulting and Transsolar KlimaEngineering
- Elevator Consultant - Soberman Engineering
- Code Consultant - LMDG Building Code Consultants
- Commissioning Agent - CFMS West Consulting
- Hazardous Materials - Pinchin Limited
- Security and Telecommunications - ZeroBit
- Construction Consultant - SCR Consulting
- Third-Party Passive House Certifier - Herz & Lang GmbH

PCL was brought on as a Construction Manager at 70% Design to provide constructability input and develop a procurement plan.

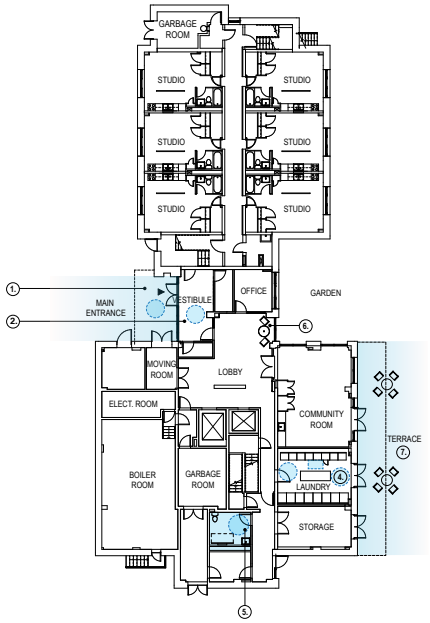
b. Integrated Design

The design team used a highly-integrated approach: an extremely high standard of coordination was adopted, with all decisions (down to the detail) requiring inputs from a number of disciplines to ensure the rigorous thermal comfort standards were being met. Weekly collaborative design sessions were hosted, with all disciplines coming to the table to discuss shared impacts of their progress. Design solutions were assessed based on their ability to meet the stringent requirements of Passive House, CityHousing Hamilton's operational needs, and constructability in the local trade context. Each design detail was validated by the third-party Passive House Certifier, after being run through rigorous thermal modelling analysis.

Regular workshops were held with CityHousing Hamilton's facilities management team, aligning the design's progress with operational and maintenance needs. This level of integrated design was rewarding and established strong teamwork from the start. The project's charter of values was consulted regularly throughout this process to guide decision-making.

TOWER RENEWAL PARTNERSHIP

ACCESSIBILITY TARGETS AND APPROACH



SELECTED ACCESSIBILITY FEATURES *

1. Accessible entrance approach with exterior overhead canopy. (CSA 7.4.1.3)

2. Accessible entrance with appropriate door clearance maneuvering space on either side of the door. (CSA 7.4.1.5.1, CSA 7.4.1.5.2)

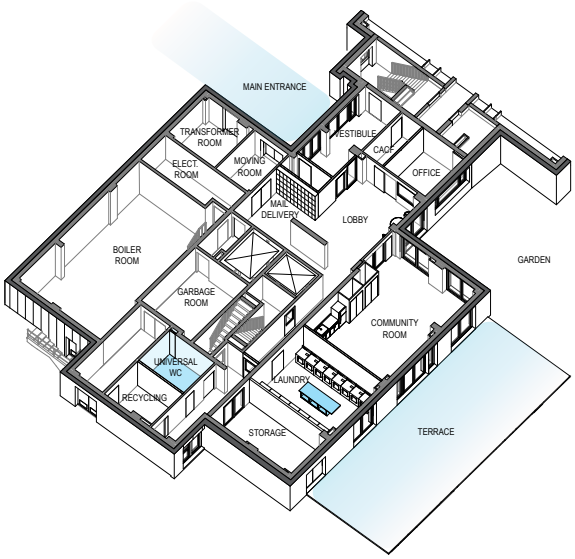
3. Doors with appropriate clearance throughout lobby and community spaces. (CSA 7.4.2.2)

4. Laundry room with 750x1200mm clearance at front-loading appliances, and 1500mm turning diameter. Folding table provided at 860mm height with appropriate knee clearance underneath. (CSA 7.4.6.6)

5. Universal washroom with 1700mm turning radius, appropriate clearances, grab bars, and adult change table. (CSA 6.3)

6. Accessible seating for those awaiting pick-up, with views to drive isle. (City of Hamilton Barrier Free Design Guidelines 5.1.8)

7. Accessible terrace with overhead canopy.



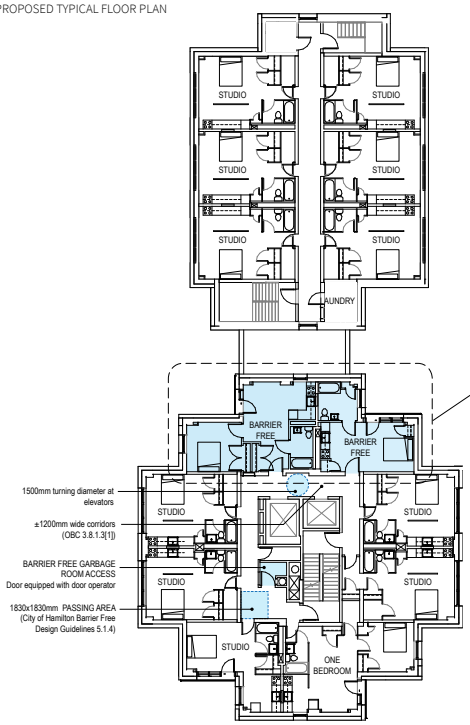
a. Target and Approach

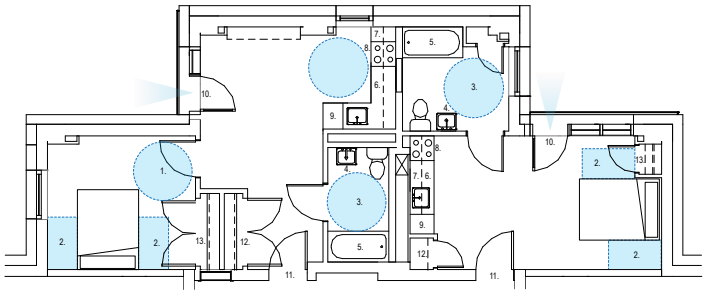
Set to be a seniors' building once complete, the Ken Soble Tower was converted to provide 20% barrier-free suites and to make all common and circulation spaces accessible. This meant that two vertical stacks of units were converted to be barrier-free, requiring those suites to be fully gutted, with all partitions and vertical risers relocated to provide for adequate clearances within the suites.

Elevators, doorways and residential garbage rooms were reconfigured to allow for barrier-free movement throughout the building. All common rooms were designed for aging in place, and outfitted with a universal washroom, while a new accessible exterior patio allows for outdoor gathering. High-contrast wayfinding signage at all floors supports those with low vision as they move around the building.

TOWER RENEWAL PARTNERSHIP

PROPOSED TYPICAL FLOOR PLAN





TYPICAL BARRIER FREE UNITS - SELECTED ACCESSIBILITY FEATURES*

ACCESSIBLE BEDROOM
1.1500mm diameter turn space
2. A clear floor area of 750x1200mm on two sides of a queen-size bed (CSA 7.4.6)

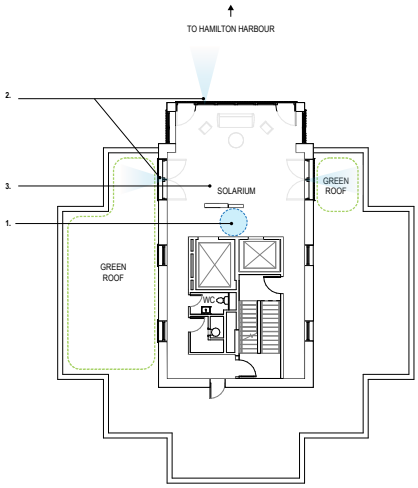
ACCESSIBLE WASHROOM
3. 1500mm diameter turn space and appropriate clearances at bathtubs, toilets, and sinks (CSA 7.4.3.1)
4. Appropriate clearance underneath bathroom sinks (CSA 7.4.3.1)
5. New barrier-free appropriate fixtures and grab-bars

ACCESSIBLE KITCHEN
6. New counter tops at 860mm high, and 600mm deep with appropriate knee clearance underneath. Section of clear counter top 760mm long. (CSA 7.4.4.2)
7. New millwork with at least one shelf at 1100mm high (CSA 7.4.4.9)
8. New kitchen sink and cook top at 860mm high with appropriate clearance under (CSA 7.4.4.4, CSA 7.4.4.6)
9. Refrigerator with freezer shelf-space no more than 1100mm high (CSA 7.4.4.8)

FULL-HEIGHT OPERABLE DOOR to new Juliette Balcony
10. Full door lite allowing exterior views (CSA 7.4.6.2)

ACCESSIBLE DOORS
11. Minimum 860mm clearance and appropriate push and pull side clearances

ACCESSIBLE CLOSETS
12. Doors that swing outward (CSA 7.4.6.5)
13. Clothes rails between 1200-1400mm and shelves between 300-1200mm (CSA 7.4.6.4)

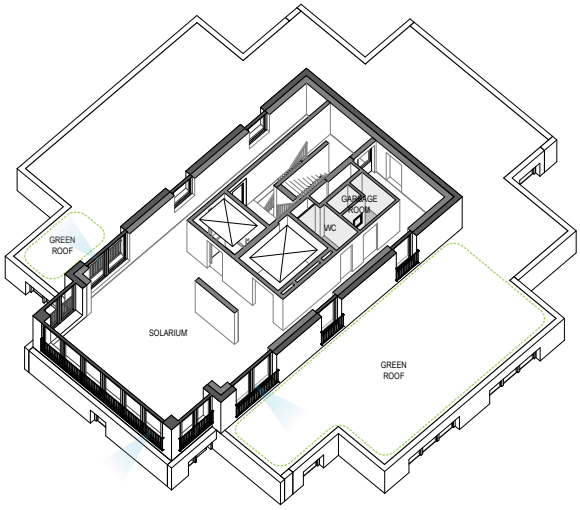


SELECTED ACCESSIBILITY FEATURES *

1. 1500mm turning diameter in front of elevators.

2. Doors with full height lites, and full height windows allow for views to the green roof and Hamilton Harbour from a seated position. (CSA 7.4.6.2)

3. Room for mobility devices within Solarium and accessible furniture.



b. Challenges

i. High Level of Intervention

The provision of barrier-free clearances in washrooms, kitchens and bedrooms required all partitions and plumbing stacks to be relocated. This level of intervention was extremely cost-intensive, with all finishes requiring replacement, and suite entry doors requiring enlargement. This level of intervention would have required residents to be relocated from their units, had the Ken Soble retrofit been undertaken with residents in place.

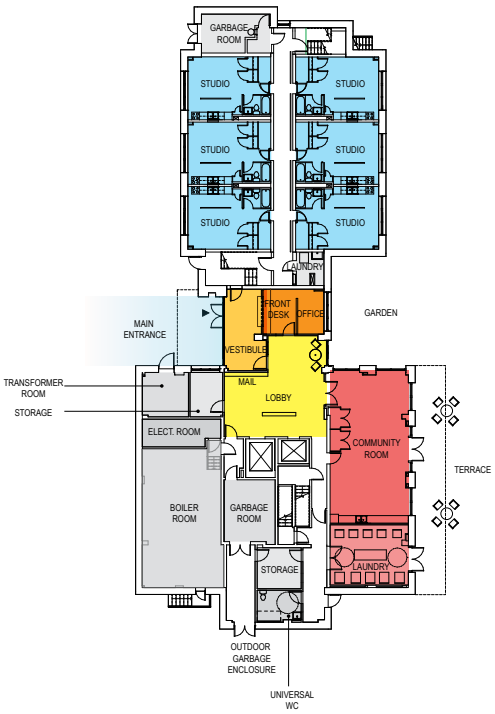
ii. Multiple Standards

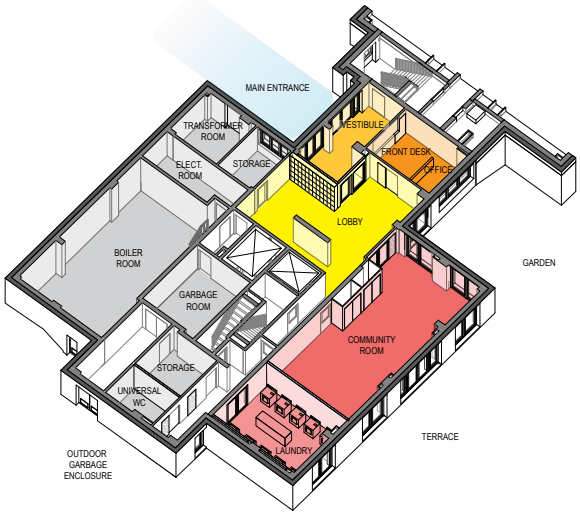
CMHC's accessibility requirements reference the CSA Accessible Design for the Built Environment Standard. These guidelines had to be met, in addition to the Ontario Building Code's Barrier Free requirements, as well as the City of Hamilton's Accessibility Standards. In some instances, there were contradictory requirements in the various standards which had to be navigated by meeting the intent of the most stringent standard in that case.

iii. Common Area Configuration Challenges

Meeting barrier free clearances in existing buildings is a challenge, where space limitations require creative approaches. Due to the small floor plate at the Ken Soble Tower, garbage chute rooms and mail rooms had to be reconceived to meet the intent of the various accessibility standards.

SOCIAL SUSTAINABILITY TARGETS AND APPROACH





a. Target and Approach

The project's social sustainability targets centred on healthy, safe and resilient housing for seniors. This was achieved through:

- Repurposing a dark laundry room on the 18th floor as a solarium, providing a bright common area with views out over the Hamilton Harbour;
- Reimagining the recreation and laundry rooms as fluid indoor-outdoor spaces, designed for social service programming;
- Designing for aging in place, using high contrast wayfinding and bright colour palettes alongside spaces designed to support community cohesion;
- Focusing on interior air quality through delivery of fresh air directly to each unit, suite by suite air flow controls, and selection of low-VOC interior finishes.

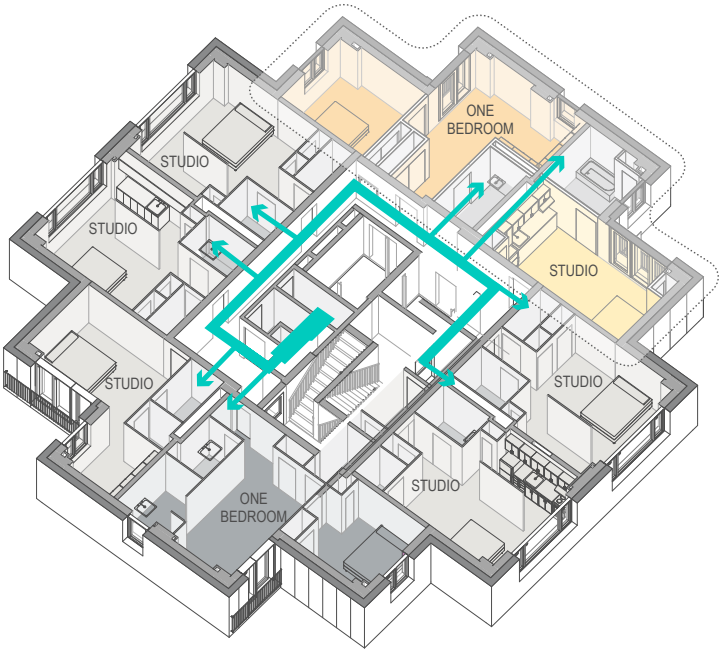
b. Challenges

i. Maximizing Limited Amenity Spaces

Post-war apartment housing did not typically provide the types or volume of gathering spaces that are expected in housing developments today. By converting a laundry room into a solarium, the design team was able to bring an expansive harbour view to a small room, encouraging gathering.

ii. Improving Indoor Air Quality

Similar to many post-war apartment towers, the original Ken Soble Tower used a system of fresh air delivery to the corridor, with undercuts at suite doors and pressurization driving fresh air into suites. Since the 1990s, it has been well understood that this system does not deliver adequate fresh air into suites, leaving most living spaces served by a volume of fresh air well below the ASHRAE standard. The retrofit introduces direct ducting through the corridors and into suites, allowing each suite to be served with adequate fresh air without contamination or air flow loss in the corridors. This approach, while effective, reduces head heights in corridors and resulted in exposed ductwork.



Direct-ducted ventilation approach

ENERGY EFFICIENCY TARGETS AND APPROACH

a. Design Target and Methodology

At 80,000 sqft, the Ken Soble Tower will be one of the largest EnerPHit-certified projects in the world once complete. Post-retrofit, carbon emissions will be reduced by 94%, and energy intensity by 70%. Meeting these aggressive energy efficiency targets required a highly collaborative and iterative process from design through to construction.

The design process involved weekly meetings with all key consultants to coordinate and ensure that the energy efficiency targets were being met and that the designs across disciplines functioned holistically to meet the stringent Passive House requirements. As the design evolved, another key consideration was to effectively communicate the intent and requirements to the trades who would bid on the project, and later work on its construction. The two main criteria that separated this Passive House retrofit from a typical renovation project were the airtightness of the building envelope and the elimination of thermal bridging. A thermal bridge is a shortcut or bypass of the insulation that allows heat to escape the building. A common example of thermal bridging is a concrete balcony slab, where a thermal bridge is formed by extending the uninsulated concrete slab from the interior conditioned space to the exterior space. Thermal bridges reduce the overall effectiveness of an envelope, and to achieve the required R38-effective envelope, the design needed to reduce their impact as much as possible.

The specifications and contract documents were developed in order to communicate the design intent and to ensure that trades fully understood the airtightness and thermal bridge considerations. The design team included performance specifications for all building envelope components that outlined the precise thermal and air tightness requirements, and if a substitution of a specified product was requested, instructions were included in the specifications for the criteria and information required to accept said substitution. Beyond the individual specifications sections, the design team developed several unique Division 01 (General Requirements) specification sections that were issued to all trades that described the Passive House project, what made it unique, and the additional requirements that were required by this project.

One of the more novel requirements outlined in the specifications was that all building trades' Foremen and Supervisors participate in a Passive House trades training session. This session provided an overview of the Passive House project and its goals, and then focused on airtightness and reducing thermal bridging. The session was attended by all trades whose work involved or was adjacent to the building envelope. The session provided an opportunity to collaborate between trades, to ask questions, to review the design intentions and address any constructability considerations.

b. Modelling Methodology

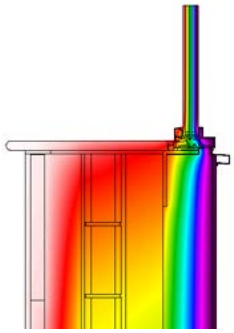
The Passive House energy model (PHPP) was developed early during the design phase, and continually updated through the design process. The Passive House consultant participated in the weekly coordination meetings and was able to weigh in on impacts to the energy model by different contemplated design elements and circulate the results. This allowed the design team to balance design intent, energy consumption, cost and constructability.

Following the formal design process, the energy model has been continuously updated during construction of the project. Any proposed changes or substitutions have been vetted through the model to understand their impact on energy consumption as well as other impacts. The PHPP model provided factual and accurate evaluation of changes and assisted the whole construction team in finding appropriate solutions to unforeseeable conditions and design changes.

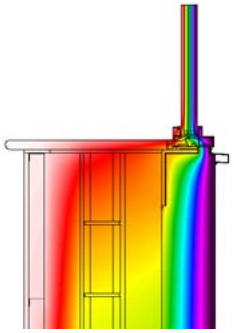
c. Construction Methodology

In addition to the requirements of the contract documents and specifications, a rigorous and extensive testing plan was developed to verify that the construction met the requirements and to diagnose any shortcomings or areas that were problematic. The testing plan included component and assembly level testing, as well as full floor and building air tightness testing. The component and assembly level testing was strictly a quality control tool, while the whole building air tightness test results form part of the submission for final EnerPHit certification.

Fiberglass Angle

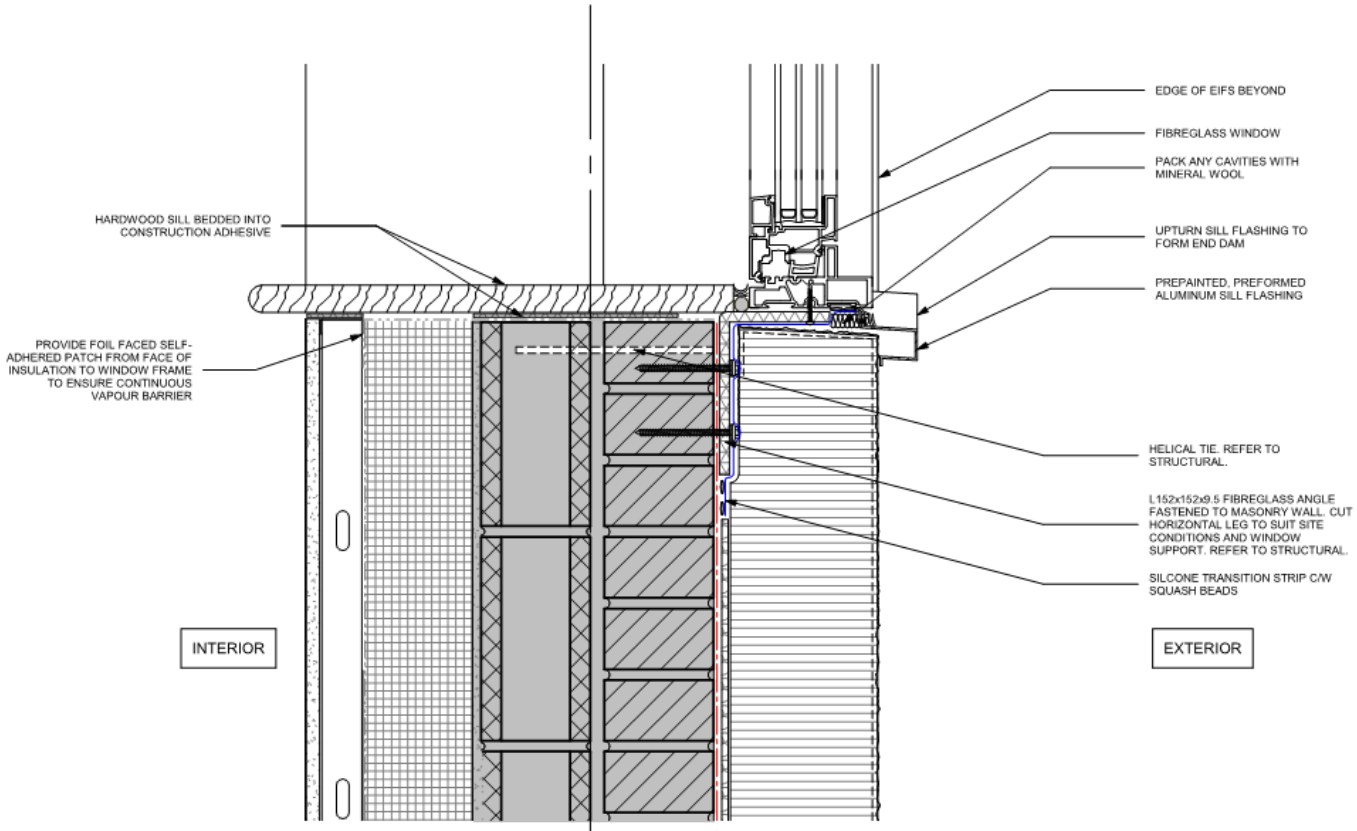


Steel Angle



	Psi- Value (W/mK)	Heating Demand (kWh/m²a)
Window Sill Detail - Steel Angle	0.114	
Window Sill Detail - Fiberglass Angle	0.086	-0.16

Thermal Bridging, Window Sill Detail



Window installation detail and construction progress image

The component testing included:

- Submission of product specific testing by the manufacturer to prove that the product meets the specifications prior to receipt of materials on site.
- Custom airtightness and water penetration testing of the windows at the factory, and before installation on site.
- On site adhesion and air leakage testing of the wall air barrier, underground waterproofing and roofing membranes.

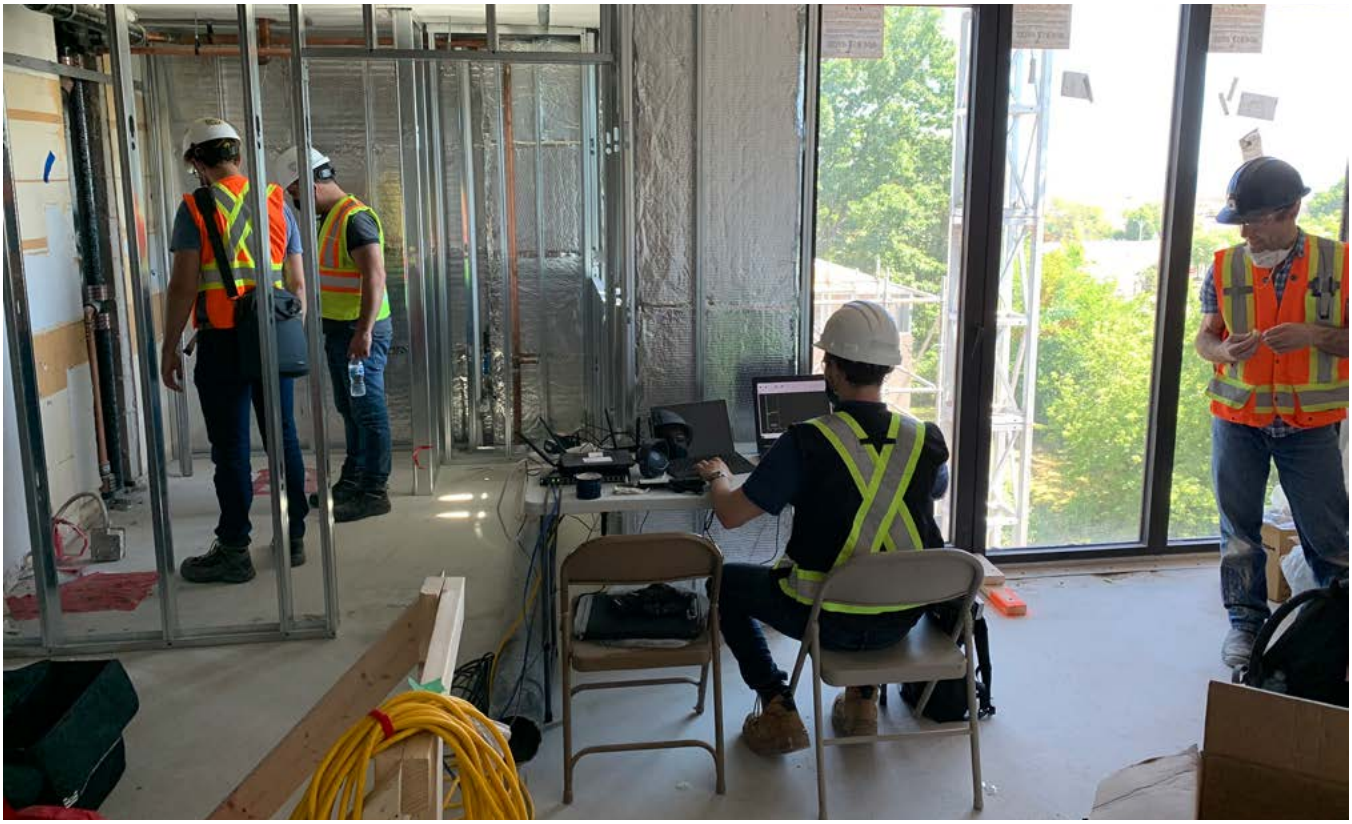
The assembly testing focused on the windows and doors and the adjacent tie-ins to the rest of the building envelope assembly. The testing regime required a series of sampling airtightness and water penetration testing that isolated and aggregated various elements to understand the air leakage that could be attributed to each component. For the typical suite windows, individual window panels were tested (fixed and operable windows, swing doors) as well as the tie-ins to the adjacent envelope assembly. Testing also occurred at various phases as components were assembled, including before and after installation of the EIFS and various flashings.

The airtightness testing plan was similarly broken into stages that aimed to identify and give an opportunity to resolve any problem areas prior to them being covered up by other work. Ultimately, only the final full building airtightness test (blower door test) is reported as part of the EnerPHit certification, however a series of interim blower doors tests of smaller portions of the volume of the building was also used. A blower door test measures the airtightness of a building by closing all windows and doors and using a blower door fan to pressurize and depressurize the building in order to measure the amount of air leakage through the envelope. In order to achieve EnerPHit certification, the building will be required to achieve an airtightness of 1.0 ACH @ 50 Pa. That is a maximum of 1.0 air changes per hour through the envelope when the building is pressurized to 50 pascals.

Guarded air tightness testing in progress

The airtightness testing plan included:

- A preconstruction baseline full building blower door test in order to understand the starting point and how far off from the targets the envelope was performing prior to upgrading;
- Three "guarded" floor tests, which are tests that isolate the volume of an entire floor to give a representative sample prior to the work of the entire building being completed;
- A final whole building blower test that pressurized/depressurized the entire volume of the building once all elements of the building envelope and mechanical systems are complete.



In-suite testing

VERIFICATION PHASE

Retrofit projects should include a range of localized investigations early in the design phase to confirm existing conditions, identity concealed deterioration, and identify constructability issues. At the Ken Soble Tower, those investigations included the following:

a. Structural and Building Envelope Investigations

- Building envelope assembly conditions (roofs, walls, slab edges)
- Window and door anchoring to structural substrate
- Tensile strength testing to confirm the ability of the exterior masonry walls to support new cladding
- Geotechnical investigations

b. Mechanical and Electrical Investigations

- Testing, adjusting and balancing of HVAC and plumbing systems
- Plumbing sampling, including pipe samples to identify corrosion
- CCTV inspections of above ground and underground plumbing systems
- Fire protection system annual inspection review
- Electrical panel conditions at distribution and suite levels

c. Building Room Audit

An extensive interior room audit was completed in collaboration between the architect and the contractor to document each room's pre-retrofit condition, including extent of damage, fire separation integrity, and elements which could be retained for reuse. A comprehensive photographic log was part of this audit, and can be referenced through construction.

An online database was created and customized to the building's context, including:

- Condition of surfaces (ceilings, walls, floors)
- Interior configuration of spaces, noting any deviations from the archival drawings
- Condition of kitchens and washrooms (millwork, plumbing fixtures, finishes)
- Condition of existing doors, windows
- Visible damage to fire separations
- Water damage
- Visible infestation

c. Data Collection

Alongside investigation, robust data collection was completed, including documents such as:

- Archival Drawings
- Building Condition Assessments
- Hazardous Materials Assessment Reports
- Maintenance logs to identify chronic issues
- Owner and operations team interviews

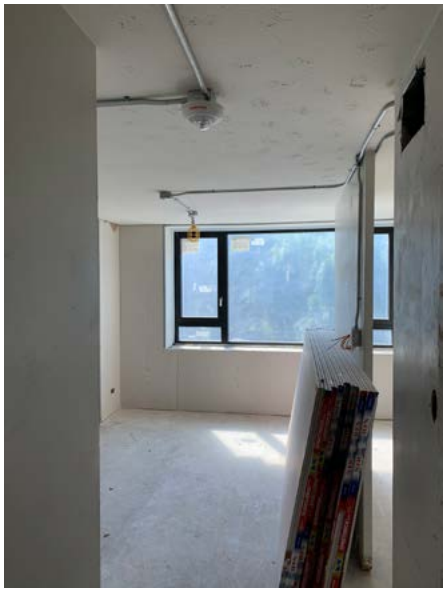
COMMUNITY ENGAGEMENT

As part of CHH's decision to rehabilitate the Ken Soble Tower, a community engagement strategy was developed to clearly communicate with both residents and the surrounding community about the building's future. Throughout 2016, CHH reached out to residents through telephone interviews and door-to-door surveys in order to gauge what people thought about the building's rehabilitation, as well as information about relocation preferences and housing needs. The response rate was 83%, and results indicated strong support for the rehabilitation of this building. The survey information gathered shaped the discussions and focus of subsequent engagement meetings. The community meetings provided information about important next steps for CHH. This included the need to develop transition plans for residents during the renovation.

Source: West Harbour Community Conversation.

Source: West Harbour Community Conversation.

PROJECT SCOPE BY DISCIPLINE



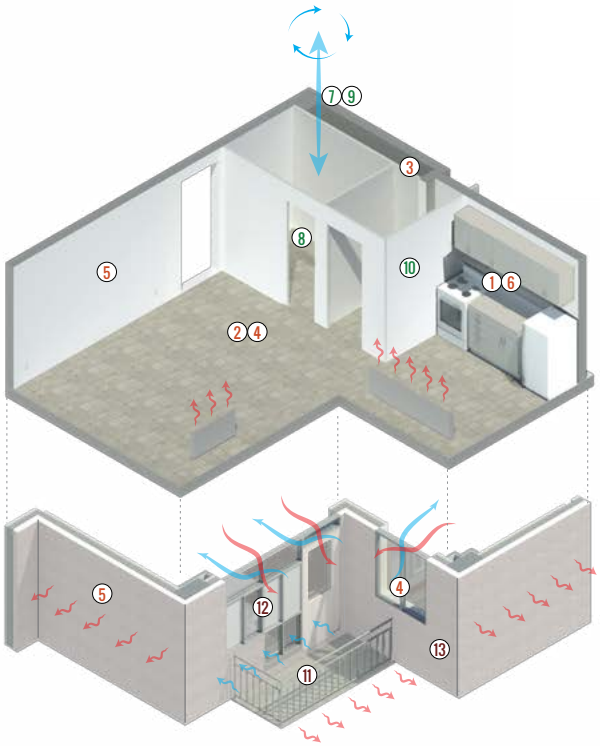
a. Building Envelope:

The Passive House approach is centred around a high-performance building envelope. Deterioration of the existing envelope was remediated prior to the addition of high-performance overcladding: the building envelope was upgraded to be airtight (0.6 ACH @ 50Pa) and highly-insulated (R38-effective). The work included overcladding the existing brick walls with a fluid-applied air barrier, an Exterior Insulation and Finish System (EIFS) comprising 6" (150mm) of non-combustible mineral wool insulation, and a synthetic stucco finish. Another 4" of mineral wool was added to the interior. Concrete slab balconies were replaced with juliettes to meet maintenance and accessibility requirements, while also eliminating thermal bridging. A combination of glazing treatments and interior blinds will mitigate heat gain, and together with the improved envelope, will reduce heating and cooling demand. Triple-glazed windows and doors were designed for ease of operability to encourage natural ventilation. The roof membranes and below grade waterproofing were replaced with fluid-applied products and upgraded with insulation up to 16" (450mm) thick. This required the addition of built up parapets, thermally-broken mechanical penetrations and New entry doors and shopfront glazing opened up the ground floor and created visual connectivity to improve safety and visibility.

b. Interiors: Suites

Typical suites received new kitchens and bathrooms, light finish improvements, new flooring and upgraded lighting. Each suite received thermostatic controls to allow tenants to control their indoor environments within a pre-set temperature range, as well as ceiling fans to improve air circulation. 31 units were converted to be fully barrier-free, with one 1-bedroom and one studio conversion on each floor of the tower. These units were reconfigured to meet the City of Hamilton and OBC accessibility requirements, as well as the CSA standards required by the National Housing Strategy. All suites received necessary repairs to existing water and mould damage.

TOWER RENEWAL PARTNERSHIP



INTERIORS
1. Deteriorated fixture, millworks and appliances
2. Deteriorated flooring
3. Holes in fire separations between units
4. Asbestos containing materials
5. Mould remediation required in all interior walls
6. Pervasive pests

SYSTEMS
7. Deteriorated central ductwork
8. Deteriorated plumbing
9. Inadequate ventilation
10. Deteriorated electrical system

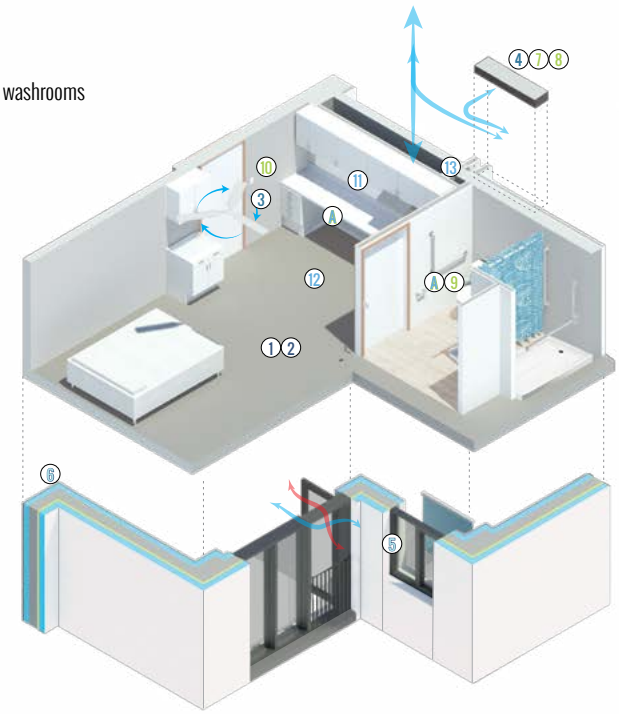
ENVELOPE
11. Deteriorated balcony slab edge
12. Deteriorated windows
13. Masonry repairs required
14. Deteriorated roof

ACCESSIBILITY
A. 20% of units fully accessible with new washrooms and kitchens meeting CSA standard

LIFE SAFETY
1. Sprinklers
2. New fire alarm system

COMFORT
3. Ceiling fans
4. Central low energy cooling

ENVELOPE
5. Triple glazed windows
6. Thermally continuous and airtight envelope with exterior and Interior Insulation



SYSTEMS
7. Direct ducting for fresh air supply in units with
8. Heat recovery
9. New plumping system
10. Modernized electrical system

UNITS
11. New kitchen
12. New flooring
13. Repair of walls for continuous fire separations between units

BUILDING AMENITY
14. New community space at base and penthouse
15. New laundry facility
16. Modernized landscape

STATE OF REPAIR
17. All state of repair issues addressed to achieve 30 year plus asset renewal

c. Interiors - Common Areas and Circulation

The ground floor was reconfigured to improve visibility, function, and sense of community. A central office provides direct views over the lobby for increased safety and sense of transparency. Seating and mailboxes were introduced into the lobby, with views onto the community garden. New spaces include a Canada Post mailroom, a moving room, and CACF room for fire department use. The community room opens directly onto the lobby, adjacent to the new ground-floor laundry room and universal washroom. These communal spaces open directly onto a shared and shaded outdoor terrace. Accessibility upgrades, finish improvements, and lighting upgrades were made to circulation routes throughout all floors, including garbage rooms. The top floor of the tower was converted to a solarium, with views and operable juliettes looking over the harbour and Hamilton skyline.

d. Mechanical - HVAC

In a Passive House building, heating and cooling demands are significantly reduced by the high-performance building envelope. The building mechanical systems were completely overhauled and modernized as part of this project. Heating, Ventilation and Air Conditioning (HVAC) is provided by new central systems that provide tempered fresh air to each suite from rooftop Energy Recovery Ventilators (ERVs), and individual control with in-suite Variable-Air Volume (VAV) Dampers with reheat. Common areas are served by smaller ERVs that are activated by occupancy sensors. The buildings systems are linked by a sophisticated Building Automation System (BAS) system that will be monitored to measure and verify that the systems are functioning as designed.

e. Mechanical - Plumbing

All plumbing systems, including risers, sanitary systems and distribution were beyond the end of their lifecycle and required replacement, including the replacement of the underground drainage system. These replacements allowed for insulation to be added to all lines containing heated water, and for waste-water heat recovery loops to be incorporated. Sprinklers were also introduced throughout the building as a life safety measure.

f. Electrical

The electrical system was upgraded to meet current code, including the replacement of equipment and grounding conductors. In-suite electrical equipment was upgraded to meet code, and individual suites were submetered for electricity. The emergency generator was also replaced. The fire alarm system, interior and exterior lighting, and exit signs were upgraded, adding accessibility features such as a universal washroom help call button and visual fire alarm indicators.

g. Structural

A moderate amount of structural repair to the existing brick and concrete exterior was required to facilitate the new overcladding and enlarged windows. Additional structural work was required for accessibility upgrades, openings for mechanical elements and to address site discoveries of existing deficient conditions that were previously concealed. Various other structural works included new shear wall or floor slab openings; balcony removal; concrete repair; masonry stabilization; support for new mechanical equipment and green roofs, and new structural framing for solarium and ground-floor canopies.

h. Elevators

Both elevators were modernized, including new cab finishes, panels and mechanical and electronic components, to improve reliability and meet accessibility standards.

i. Site and Landscape (including accessibility upgrades)

The exterior site received improvements related to accessibility, connectivity, and safety. In addition to a number of deferred maintenance repairs, main gathering areas at the front entrance and outside the community room were upgraded. An informal pedestrian circuit, outdoor terrace, community gardens, upgraded planting, seating and lighting create safe and accessible spaces for gathering. All planting was designed for increased ecological resilience, with sub-surface rainwater collection integrated into the site.

PROJECT DELIVERY & CONSTRUCTION MANAGEMENT

A number of delivery models were considered at the Ken Soble Tower, with Construction Management ultimately selected for its transparency, for pre-construction collaboration, and for the ability to fast-track work.

To achieve cost certainty, the contract was a CCDC 5b which was converted to Stipulated Sum after all scopes of work were awarded. This method had a number of benefits over the traditional design-bid-build CCDC2 model:

- Allowed for a four-month period of construction support from the Construction Manager, during which a constructability review was completed, a collaborative building site audit was conducted, and a procurement strategy was designed with input from all parties.
- Allowed for the unique challenges of Passive House construction to be understood by all parties, with the Construction Manager and its subtrades receiving on-site trades training as part of the tender process.
- Allowed for constrained timelines to be met through phased procurement.
- Allowed for transparency on market pricing, which enabled more precise value engineering decisions to be made to align the project cost with budgets.

The contract was converted to a Stipulated Sum approximately two months into construction, in September 2019.

07. DESIGN COST-BENEFIT ANALYSIS

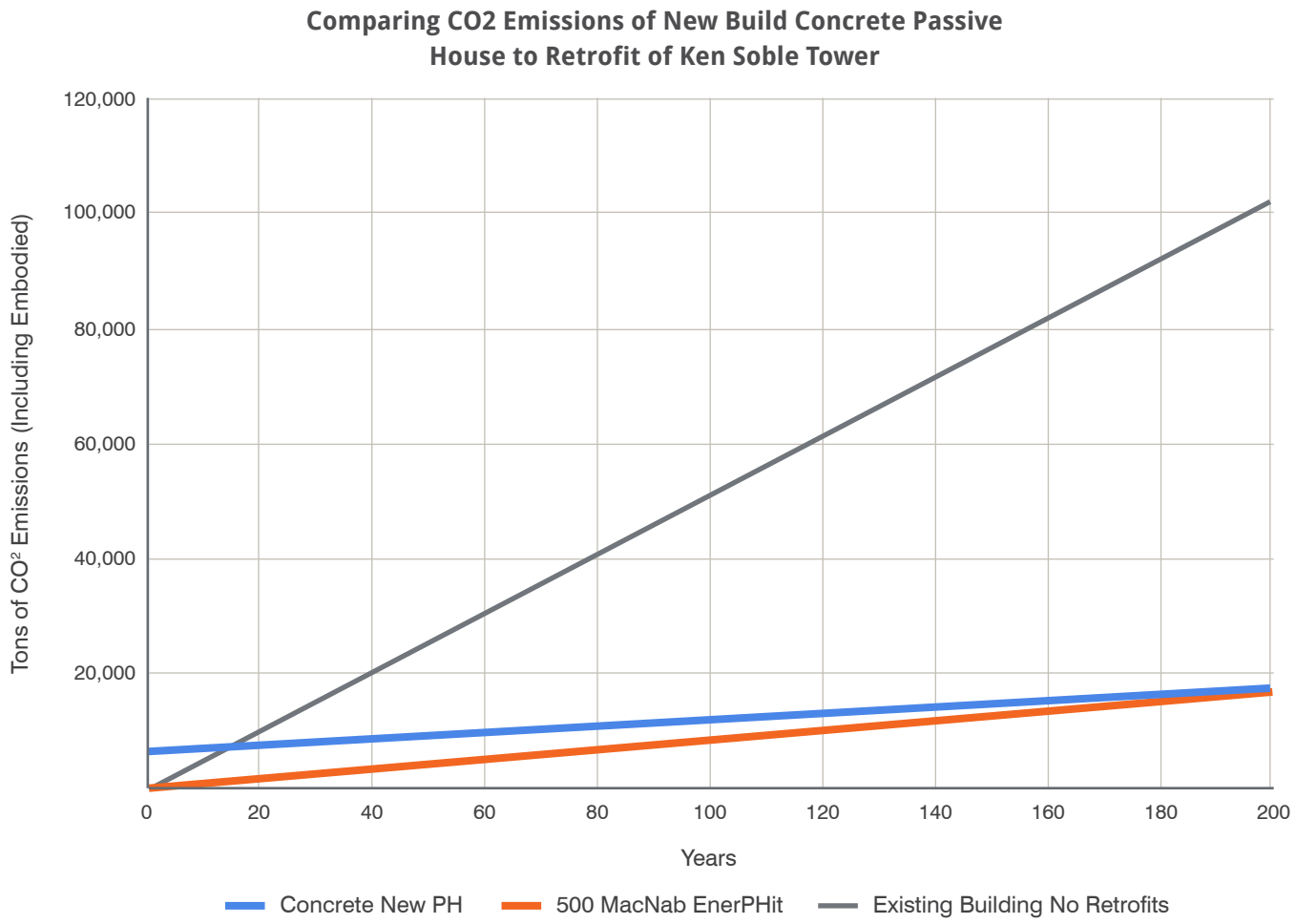
The decision to retrofit rather than replace 500 MacNab was undertaken following an analysis of the social, economic and environmental costs of each option. It was also balanced by the opportunities presented by existing funding tools, and through an urgency to find solutions for this again housing type.

Cost of Retrofit vs. Rebuilding

In 2016, CityHousing Hamilton engaged Deloitte LLP to undertake a cost benefit study of retrofit vs replace and rebuild. The conclusions of the report recommended a retrofit approach due to the cost of reconstruction surpassing those of retrofit, while also resenting additional challenges related to site zoning and planning approvals that would extend project schedules. Current order magnitude costing predicts $45M-$50M for a comparable new construction -- and this excludes demolition costs, which can add several million to that figure. Together these costs are significantly higher than the Ken Soble project budget. From a project cost perspective, retrofit to a Passive House level is more economical than demolition and replacement.

Cost of Embedded Carbon

An additional project consideration is embedded carbon. The embedded carbon in concrete is high – higher when the concrete was constructed in the 1960s. As part of the project analysis the carbon impact of demolition vs retrofit was assessed. If the building had been demolished and replaced with a new Passive House building, it would take 180 years to emerge as carbon neutral – meaning that the building has saved as much as lost in embedded carbon through demolition. Further considerations regarding embedded carbon can impact the project related to material selection used during the retrofit project.



Social Impact

Neighbourhood consultation by CityHousing Hamilton has confirmed that the Ken Soble Tower, and its affordable housing units, are a valued community asset. Reconstruction would have resulted in a longer and more invasive period of demolition and construction, negatively impacting the local community. And a new build would likely have involved an expansion of tenure mix, including market housing, to offset projects costs, with the potential of eroding the total supply of affordable units in the neighbourhood – something the community wished to avoid.

Showcase of What is Possible for this Housing Type

CityHousing Hamilton has several mid-century apartment towers in their portfolio, as do most social housing providers across the country. While the Ken Soble Tower was empty, nearly all other towers across the country are fully occupied, making the consideration for demolition further disruptive. A significant consideration for the Ken Soble Tower was to demonstrate what is possible in the preservation of this critical housing resource, not just in this location but across CityHousing Hamilton's portfolio, and more broadly across the country.

Additional Costs to Achieve Performance: Opportunities for Supply Chain Innovation

Not all decisions for the project related to cost efficiency. By virtue of being a showcase project, demonstrating healthy, resilient and low-carbon retrofit potential, the project incurred some costs which might be reduced in future, as the supply chain of the retrofit market continues to expand. Select examples include the use of mineral wool insulation rather than EPS – a net cost to the project that substantially reduced the project's embedded carbon, and eliminated any fire risk in the exterior insulation assembly. Other examples relate to the selection of Passive House certified windows and ERV units. As the market pool expands for these products, it is anticipated that competition will drive prices closer to the cost of conventional (ie: non Passive House) products. The showcase of this approach to retrofit is part of the process of growing the market.

Funding Opportunities

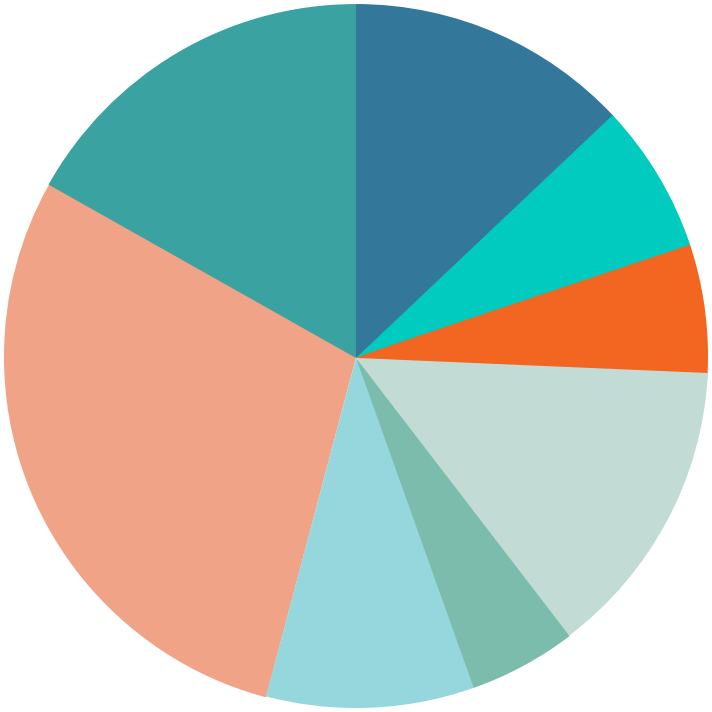
As the Ken Soble Tower was in its feasibility stage, several funding streams came online specifically focused on retrofit: provincially, federally and through FCM. Access to these funds were a significant driver in the decision to engage in the retrofit project.

TOWER RENEWAL PARTNERSHIP

PROJECT COST BREAKDOWN

Breakdown by Division	
Scope of Work	**Percentage of Cost**
Demolition and Abatement	12.0%
Mechanical and Plumbing	18.1%
Electrical and Fire Alarm	7.0%
Elevator Modernization	2.0%
Concrete	0.4%
Roof Anchors	0.4%
Structural Steel & Misc. Metals	0.7%
Mould	7.5%
Cooling	1.6%
Sprinklers	1.8%
Drywall	5.3%
Millwork	1.8%
Flooring	2.3%
Caulking	0.5%
Painting	1.6%
Doors & Hardware	2.1%
Washroom Accessories	0.2%
Misc. Accessories	0.1%
Signage	0.1%
Final Clean	0.2%
Façade Repair and Cladding	4.4%
Excavation	0.2%
Waterproofing	0.4%
Masonry	1.9%
Windows	6.7%
Roof	3.6%
Testing	0.3%
Access Equipment	3.0%
Landscape	0.8%
General Conditions and Fees	16.6%

A significant portion (almost 30%) of the total project cost went to addressing “state of good repair” objectives, with a further 14% to interior fit-out related to state of repair. Antoher 10% went toward mould and asbestos abatement. Since the Ken Soble Tower required significant work to bring into a good state of repair, these percentages suggest that a building in better condition would be able to pursue similar energy upgrades for a reduced total project cost.



BREAKDOWN BY OBJECTIVE

Objective	Percentage of Cost
Energy Efficiency	13.1%
Passive House Premium	7.1%
Accessibility & Social Inclusion	5.8%
Interior Fit Out	13.9%
Life Safety	4.8%
Mould and Asbestos	9.3%
State of Good Repair	29.3%
General Conditions and Fees	16.7%

08. PROJECT DOCUMENTATION

DESIGN AND CONSTRUCTION SCHEDULE OVERVIEW PROGRESS BY DISCIPLINE

Activity	**Start Date**	**Finish Date**
Feasibility Study	January 2017	February 2017
Design Phase	July 2018	March 2019
Tender	March 2019	June 2019
Construction	29 July 2019	20 May 2021
Envelope	14 April 2020	26 Oct 2020
M&E	06 January 2020	27 October 2020
Finishes	08 September 2020	26 February 2021
Occupancy	12 April 2021	


ONYX

Architectural


Demolition of Entrance Canopy


Mast climber erected at south side of tower


Interior selective demo in Block A


Selective ceiling demolition at Level 17


Juliette windows are installed


Interior insulation installation


Floor grinding underway at level 5


Roof membrane with wood blocking installed


Solarium window installed


EIFS overcladding mockup with air barrier installed


Block B roofing progress


Interior finishes in suites

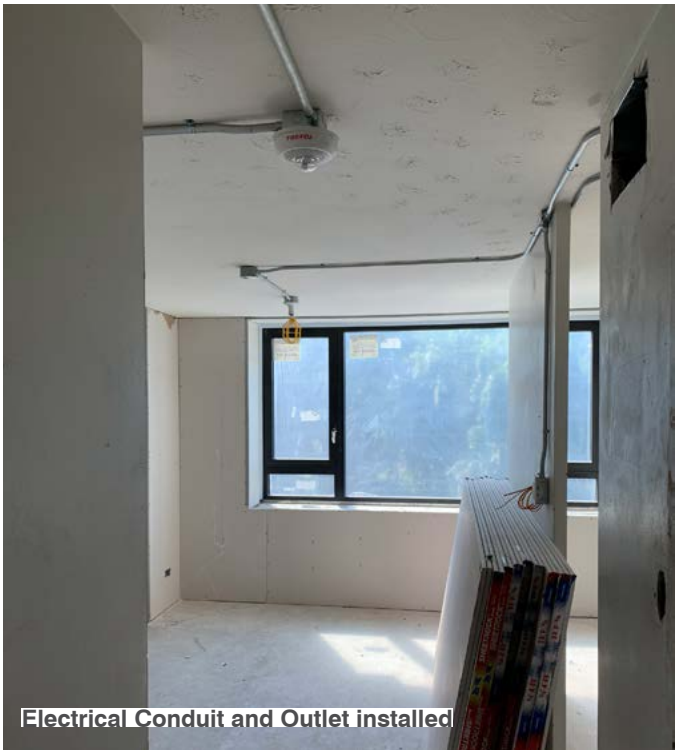
Electrical

Existing Electrical Unit

Exposed Conduit of Fire Alarm in Suite

Fire Conduit, Sprinkler system and Hvac system installed in Corridor.

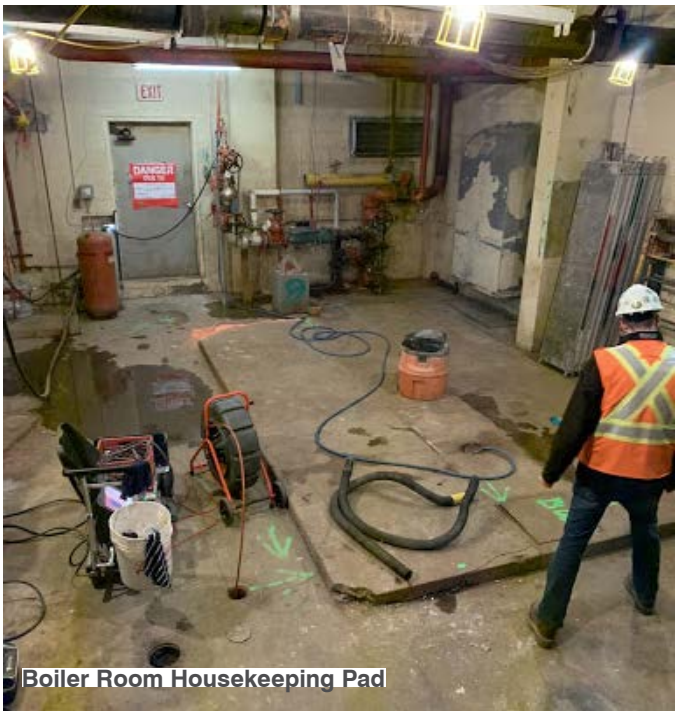
Electrical Conduit and Outlet installed after Interior insulation



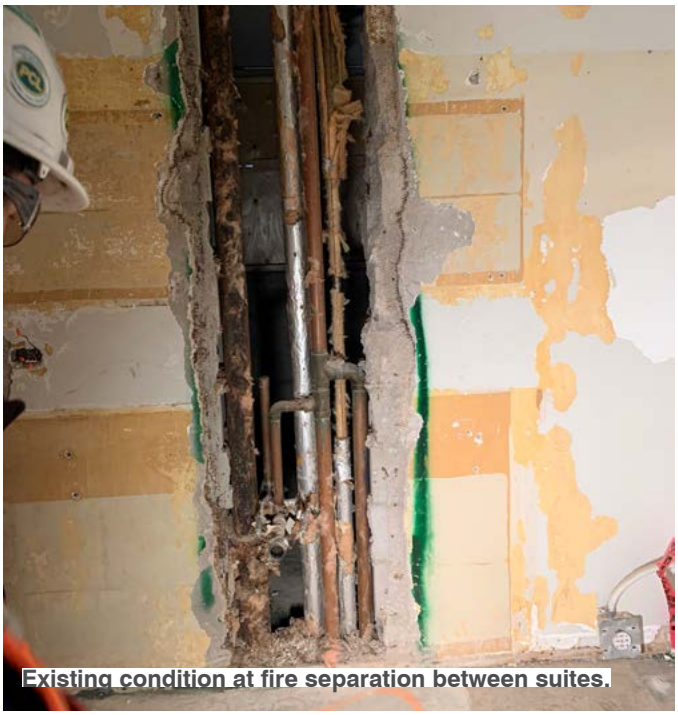
Electrical Conduit and Outlet installed

Interior finishes in suites

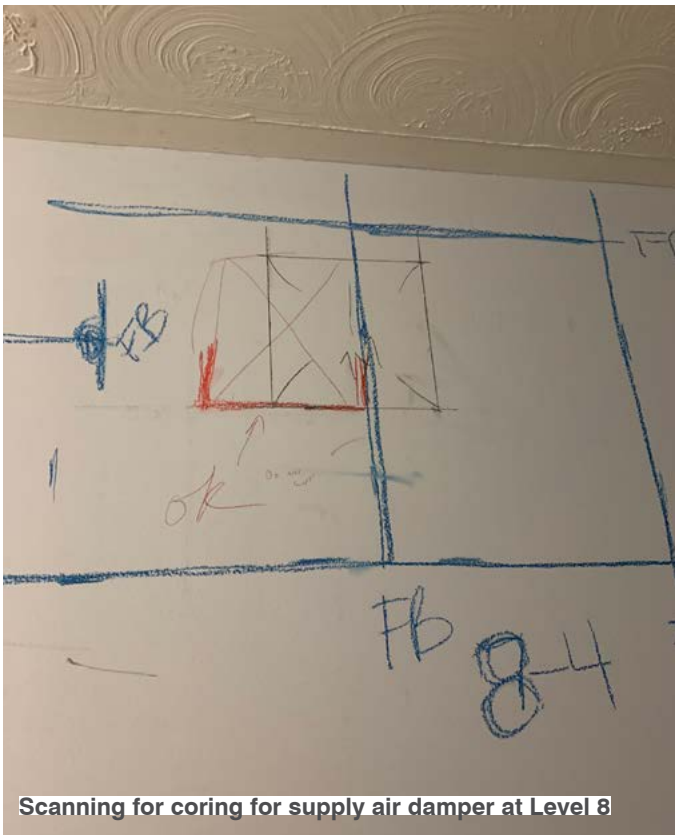
Mechanical



Boiler Room Housekeeping Pad


Existing condition at fire separation between suites.


Existing sanitary pipes in poor condition.


Scanning for coring for supply air damper at Level 8

Central shaft demolition

New Plumbing installed

New Plumbing installed and framing underway

Reuse of existing janitor sink

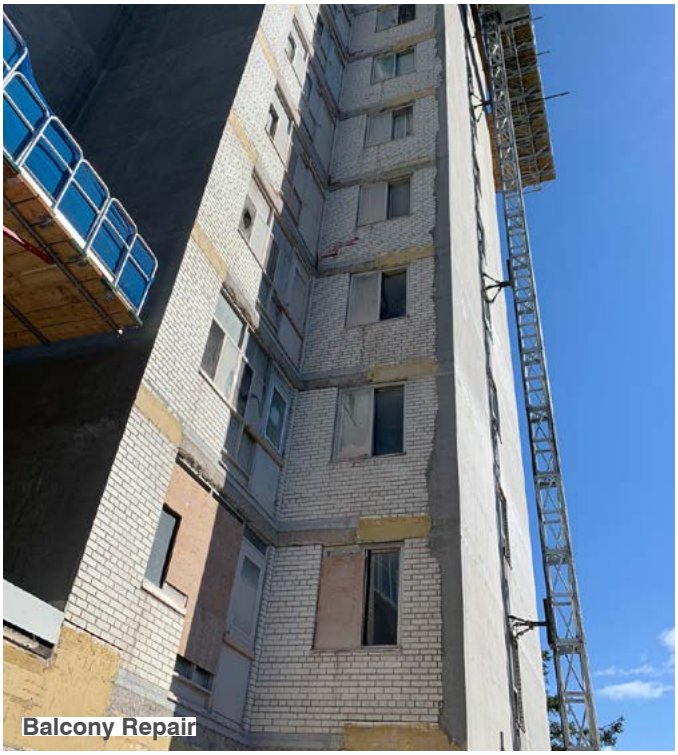
Structrual

Balcony Demolition

Investigative opening in the solarium

Ongoing cutting, trenching and excavation in the Mechanical Room in Block A.

Missing block from Fire Separation in Block B Level 02


Balcony Repair


Windows Installed

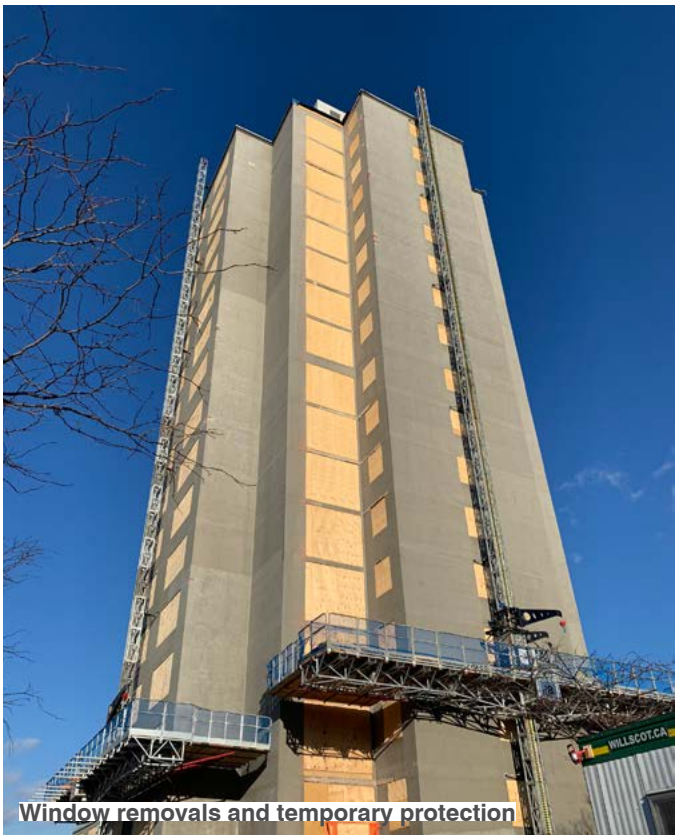

Existing Door Infill

Envelope


Partial Balcony Demolition


Helical tie pull-out test from mortar joint


Fluid applied air barrier application


Window removals and temporary protection


Air testing at window


Water testing at installed windows


Air tightness guarded floor by floor testing


Mineral wool being Installed

09. LESSONS LEARNED

Retain specialized expertise and develop standards

In order to successfully carry out the Ken Soble project, CityHousing Hamilton hired a development lead with urban development experience as well as internally putting together a team with development expertise. With the expertise in place, CityHousing Hamilton could figure out how to project manage, procure, and manage real estate transactions. CityHousing Hamilton brought on Project Management services through the City of Hamilton for the execution of the Ken Soble project, which allowed them to draw on the City's experience with complex construction. CityHousing Hamilton also introduced design guidelines for architects and designers to reference: for organizations undertaking many complex retrofits or new construction, developing design standards for things like HVAC, IT, and even finishes, can help to streamline maintenance and operations, while simplifying the design process.

Treat retrofits differently than new construction

Destructive and comprehensive investigations are critical, as well as having an allowance for the unforeseen. This helps to understand the elements that are issues and may present additional costs or additional work, and are better identified within or as close to feasibility as possible. Look carefully at the extent of the renovation and undertake robust investigations, especially at those extents, to minimize the impact of unforeseen conditions. Use mock-ups to help identify problem areas. And be sure to carry appropriate contingencies throughout the project lifecycle: for retrofits, 15% contingency should typically be carried, which is different from new construction.

Find champions for the right deep retrofit project

For housing providers considering deep retrofits, doing retrofits across a number of buildings will likely happen more frequently than "one off" projects like the Ken Soble Tower, which was an opportunity which resulted in large part due to the high financial requirement for capital repair. However, when significant envelope deficiencies exist, there is a significant opportunity to target Passive House performance. It is also important to consider the unique political, financial and internal vision of housing providers or municipalities as this will determine if deep retrofit projects are in alignment. A project of this magnitude needs champions and supporters within the organization.

Credit: Doublespace Photography

Anticipate organizational efforts required to secure funding

When pitching proposals to potential funders, it is useful to access seed funding to complete feasibility work including establishing project costs as early as possible. For this project, CityHousing Hamilton used a stacked funding model, leveraging several different funders. Considerable staff time was taken applying for and once secured, aligning funding agreements from FCM, CMHC and the City of Hamilton. Funder requirements also proved resource intensive as funders required multiple different submissions to ensure funding requirements were met.

Design the delivery model to suit the needs of the project

Both the Construction Management and General Contractor routes have benefits. The CM model allows for a collaborative approach between the Contractor, Consultant and Owner from the design phase onward. This approach can allow for more flexible and transparent procurement, faster start-up, and reduce risk to the Owner due to site discoveries. On the other hand, the GC model can provide more cost certainty. At the Ken Soble project, the conversion of the CM contract to a Stipulated Sum after tendering was complete provided some of the benefits of both models.

Prepare for educating users and tenants as part of the occupancy period

CityHousing Hamilton will need to conduct an educational program for residents - in the form of something like a “welcome kit” or guide - to assist with residents’ adjustments to their new unit and low-energy features. Further training and onboarding will also be required for in-house CHH maintenance staff and property managers. The post-occupancy study planned for the Ken Soble Tower will be part of this process, allowing for observations made during data collection and interviews to be converted into educational material.

Design projects understanding user behaviours

At the beginning of the project, determine how wasted energy and water caused by inefficient tenant behaviour will be addressed. This should drive some of the key decisions that need to be made about the mechanical system design, controls and metering equipment. Consider control equipment that restricts the available energy and water resources such that higher-than-average levels of occupant energy and water consumption, regardless of behaviour, are restricted. If evenue submetering is an option, consider purchase & install vs. a submetering contract and the associated capital vs. operational costs. This approach addresses wasted energy and water by incentivising tenants to save money through efficient behaviour.

Ensure that facilities and operations teams are kept informed throughout the design process and through construction

Regular workshops with the design team during design allowed the facilities team to stay current and provide input on the design throughout the process. During tender and construction, maintaining a level of information flow is helpful, as designs can continue to change during those periods.

Addressing capital repair needs were much more cost-intensive than meeting the Passive House targets

While the Passive House targets required a high level of coordination and detailing, the costs associated with this target formed a much smaller portion of the budget than the capital repair works, which were extensive in this building. Decades of known backlog were the starting point, but as the design progressed, unknown deterioration was uncovered which needed to be addressed as part of the project. Robust contingencies and comprehensive investigations are critical when dealing with existing buildings.

Meeting barrier-free targets in existing buildings is capital-intensive and cannot easily be completed with residents in place

Providing barrier-free suites within the affordable housing stock is a critical goal. However, meeting this target within an existing building is capital intensive, requiring the relocation of vertical risers, movement of most interior partitions, and often enlargement of openings in shear (structural) walls. These modifications will almost always require the relocation of an existing tenant for up to two weeks, while work is completed in their units. The costs of the work and the relocation should be factored into funding programs.

The Ontario supply chain has gaps in high-performance retrofit products

A number of technologies that are standard and affordable in European countries are not yet widely available in the Canadian market, requiring alternative approaches to achieving the Passive house targets. These included: external moveable shading, high efficiency elevators and appliances, standard thick external insulation systems, high performance Passive House certified high-rise windows, affordable decentralized ventilation units, affordable low-capacity hydronic or heat pump based in-suite heating and cooling units, and domestic hot water generation options outside of high-efficiency centralized condensing boilers. As a result, a more North American approach was taken in the centralized ventilation, heating, cooling and hot water systems, and by incorporating heat losses from North American building components, such as code-required back-up generator block heaters, garbage chutes, recirculating centralized domestic hot water, and standard elevator machines. As Passive House and high performance retrofit become more standard in the Canadian market, those market gaps will be filled as manufacturers begin to compete.

The overcladding approach met all project objectives but is not commonly used in our market

The existing 1960s structure was made up of composite masonry walls with limited interior insulation and vapour control layers, as well as thermal bridging at exposed slab edges. The cladding upgrade was designed to minimize intervention to the existing masonry, for thermal and structural reasons, and to limit combustibility and embodied carbon: resulting in a selection of 150mm of mineral wool-based insulation as part of an EIFS system. This type of assembly is not commonly used in our market, and training, typically provided by the mineral wool manufacturer, can help to improve trade familiarity with the assembly as its application begins to scale up. By familiarizing the construction industry with the unique requirements of Passive House buildings, it will be possible to successfully execute projects in an increasingly affordable, efficient, and low-risk manner. In part, this will require the ‘demystification’ of the standard, which is deliberately low-tech and relies largely on standard construction methods.


STOP

Active cooling should be considered in multi-unit residential Passive House buildings

Designed in Europe, the Passive House standard can at times be at odds with Ontario's humid climate and local building code. Most of Europe does not experience the humidity of the east coast of North America -- peak wet-bulb temperatures are typically under 24°C in Europe, but 30°C or higher in Ontario -- and therefore the standard does not necessarily take into account the negative health and comfort impacts of humidity. While the Passive House standard relies on ventilation without additional cooling systems, the design team identified a high risk of overheating due to high relative humidity in the regional climate zone. As such, a centralized air conditioning system was integrated into the design, with resulting impacts on the Passive House energy budget.

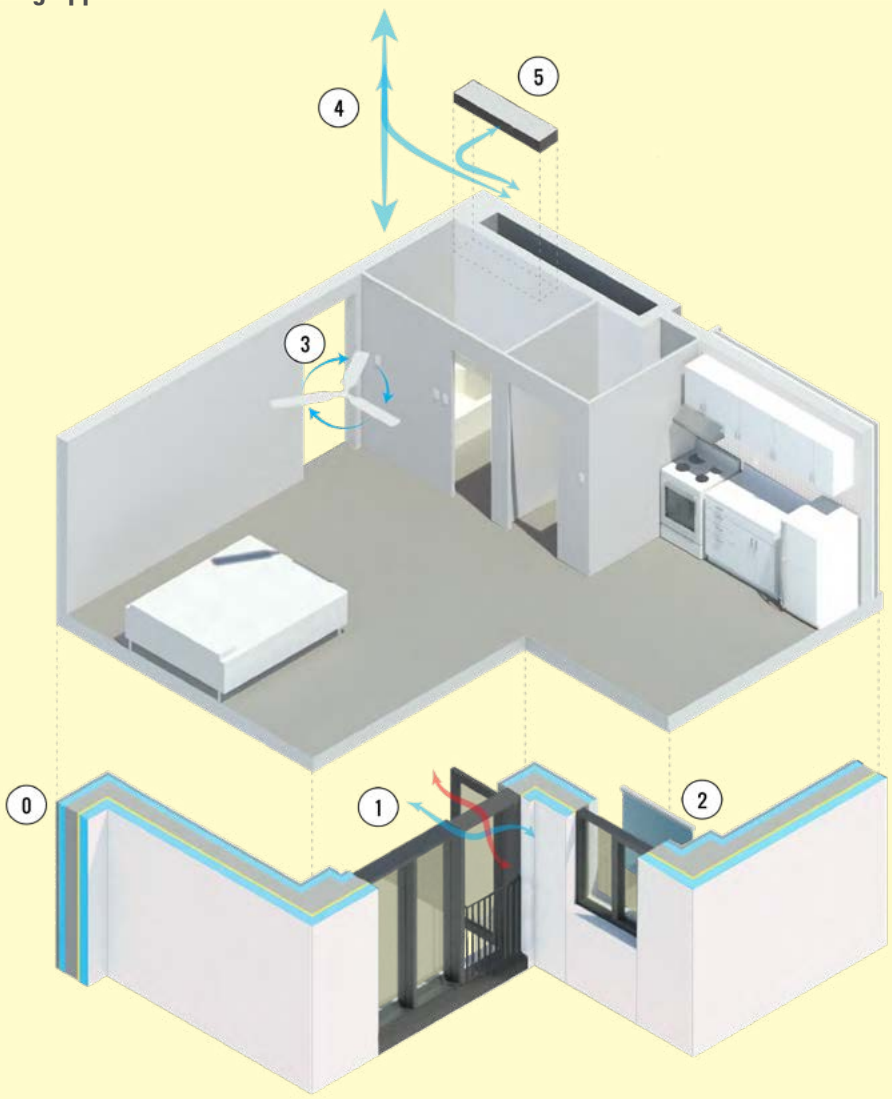
Low-flow commercial VAV units are needed in our market

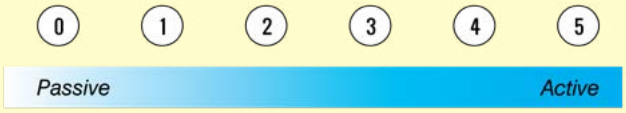
The team evaluated multiple ventilation standards to determine appropriate minimum fresh air and exhaust air rates for each suite, including OBC Part 9, ASHRAE 62.2-2016, and EnerPHit recommendations. Ontario and ASHRAE code ventilation requirements were higher than EnerPHit, in particular minimum kitchen and washroom exhaust standards, which required the team to reduce energy use in other areas to compensate for the higher ventilation rates. The minimum design air flow rates to each suite are still at the very low end of what can feasibly be delivered by any commercial VAV unit, and will require both high performance VAV controllers and an experienced commissioning team to achieve the required low-flow balancing. To aid in balancing, the building, which originally had fresh air and exhaust only from the roof, was divided into two seperate air handling zones of nine floors, each served by a separate air handler.

Clean electrical grids are not yet recognized by the Passive House Institute

The team discovered that perspectives on how to evaluate the impact of grid electricity vary from OBC to PHPP. The team selected heat pumps as the primary heating source for the fresh air system in the building, with electric resistance back-up, reasoning that Ontario's grid energy is low-carbon compared to burning natural gas for heat. However, the PHPP model also evaluates primary energy use at source, rather than at site. This resulted in an initial model showing source energy use that exceeded targets, since line electricity losses in Ontario are high even though much of the source is hydro-electric and nuclear. This additional criteria forced the mechanical team to reselect the heat pumps to provide higher part-load performance, allowing the heat pump system to meet all PHPP targets, and improving the final building energy performance across every measure.

Five-stage cooling approach





0. R38 Effective Envelope
1. Glazing with a low Solar Heat Gain Coefficient
2. Low emissivity interior shades
3. Ceiling fans to circulate air within units
4. Lightly tempered air delivered through a centralized ventilation system
5. Decentralized cooling 'boost' through a Variable Air Volume Unit activated by in-suite controls

Meeting stringent air tightness requirements requires a thoughtful plan, with all players collaborating to achieve success

To meet the strict air leakage criteria (targeting 0.6 ACH at 50Pa), a multi-phased approach to field testing was implemented. This included the required Whole Building Air Leakage test, supplemented by targeted mockups and "guarded" floor-by-floor testing to provide assurance that the project is on track to meet the final test as construction progresses. The design team included a requirement for an "air boss" and trades training into the Construction Manager's responsibilities, to support the day-to-day monitoring of the air barrier's integrity on site, including maintaining a high level of rigour throughout installation, with every key trade receiving Passive House training.

Post-occupancy evaluations are crucial to confirming success

While standard Measurement and Verification programs can evaluate whether energy targets have been met in the post-occupancy period, these programs are not calibrated to measure whether comfort, resilience and health targets have been met. To measure these types of outcomes, new post-occupancy evaluation programs are needed. The evaluation matrix developed for the Ken Soble Tower provides a useful template for those studies. However, funding for those types of post-occupancy studies are also needed, as well as specialized practitioners who can provide those evaluations in a consulting capacity. This is a potential area for growth in the sector.

10. MONITORING EQUIPMENT AND INSTALLATION PLAN

MONITORING AND EVALUATION PLAN

In order for the Ken Soble Tower Renewal to serve as a demonstration project, a comprehensive evaluation must be made available as a case study for other housing providers, practitioners, and decision makers. The monitoring and evaluation plan will provide a qualitative and quantitative evidence base for performance, economic and social outcomes, while identifying elements of the renewal which were most effective, and which posed the most challenges for key stakeholders. As deep retrofits become more common across Canada, this evidence base can be expected to be used widely in decision-making.

In order to evaluate the energy benefits of the project, a range of sensors will be installed to measure a number of factors inside the buildings including a sampling of suites, corridors and common spaces.

The non-energy benefit evaluation plan for the Ken Soble Tower aims to track the social, health, economic and general well-being impacts of the renewal project. These types of benefits have tremendous value for individuals, housing providers and public policy, but are less commonly tracked than energy benefits.

The monitoring study which will be executed by the University of Toronto is under development. The equipment is scheduled to be installed once the construction is complete.

The proposed monitoring and evaluation plan has two components:

1. Track energy and comfort performance - *Milestones at 6 months, 1 year, and 2 years post-occupancy*
    1. Use BAS on major systems to monitor overall building use
    2. Install suite-level monitoring on a selected number of suites, using a tenant engagement plan to secure tenant collaboration
    3. Track local weather data to tie use to real exterior conditions
    4. Provide ongoing communication/education to tenants and operators
2. Track social and economic benefits - *Milestones at pre-occupancy, 6 months, and 1 year post-occupancy*
    1. Use CityHousing Hamilton data and logs to monitor building-scale impacts
    2. Conduct surveys and hold interviews to gather individual-scale impacts
    3. Develop a comprehensive analysis and report; disseminate findings

ENERGY BENEFITS MONITORING APPROACH

The goal of this study is to monitor the building's operations as it relates to performance, comfort and occupant use:

1. **Building Performance:**
    a. Air flow on different floors are properly balanced (note that in many high rise towers, ventilation is not evenly distributed despite balancing efforts due to lack of air tightness and stack effect).
    b. Temperature control is effective (both in heating and cooling mode to confirm that users are able to achieve the comfort desired and are using the different options to do so (changing the thermostat, opening the window, turning on the ceiling fan)
    c. Ensure ventilation rates are sufficient to maintain fresh air in the space (measuring VOCs, CO2 and other air quality metrics). These measurements will identify if the rates are sufficient or require increased air flow and identify if VOCs are from materials in the suite or from occupant's own items / cooking.
    d. We will also use user surveys to understand if these different controls and functions are working for the occupants. If they are using an auxiliary heating or cooling device this will also be metered and noted.

2. **Comfort Performance:**
    a. The design team has predicted that independent of certain outdoor conditions, it will be possible to maintain comfortable indoor conditions. With these measurements, it is possible to confirm that the systems are working as planned but also identify through logging complaints or requests for additional cooling if the system is not working for all occupants.
    b. Similarly in winter, maintaining a certain indoor air temperature is expected to keep occupants comfortable. The measurements will help identify if this is not happening and the causes.
    c. Occupant surveys will be used to understand if the conditions that predict comfort (air temperature, solar gains, air movement, relative humidity) are reflecting the comfort of the occupants.

3. **Occupant Use:**
    a. Ultimately, different occupants use spaces differently. By measuring different suites it will be possible to identify if there are extremely different trends by user and to provide education to users on how to better take advantage of comfort controls available to them.
    b. By measuring window openings, air flow rates and ceiling fan usage when different behaviour change strategies are used (ie posters in the elevator, individual conversations, etc) through both measured data and occupant surveys the effectiveness of these interventions can be determined.

SCALE OF ENERGY BENEFITS STUDY

1. Minimal
    a. Aiming for qualitative information. A minimum of 6-10 suites would be metered. Meters could be moved to other suites during the study to meter multiple units for a lower price.
    b. This approach would provide good data for understanding how the building is performing at different times but may be difficult to provide truly comparable results or anything scientifically viable should CHH or CMHC decide to commission any academic studies or papers.
2. Scientifically Valid
    a. Aiming for a statistical relevance of 75% or better, the minimum number of suites measured would be 21. This would involve a set of suites on all three floors of the Annex as well as on at least 2 floors of the tower. Common areas monitored include: corridors on the same floor as units being monitored as well as commons rooms and the sun room.
    b. Suites on each façade orientation, on each floor would be used to provide comparable results.

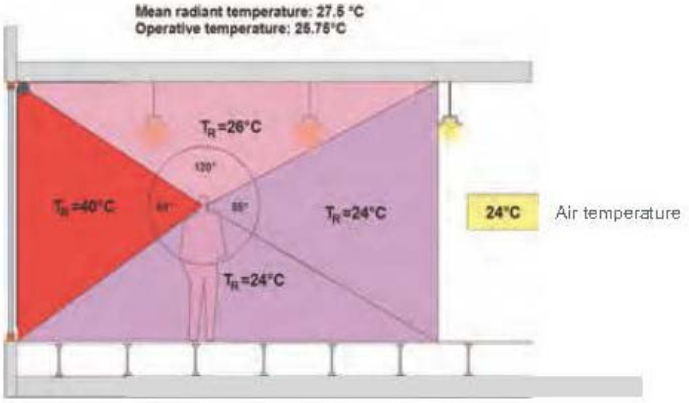
Objective	Category	Metrics	Measurement Approach	Measurement			
				Base Renewal Project Scope	M&V Added for Purpose of Study	CityHousing Hamilton Data	Social Data Collection via Interviews and Surveys
Health	General Health of Residents	Emergency Room Visits	Self-Reported through Interviews				X
		911 Health-Related Calls	CHH Tracking			X	
		Doctor Visits	Self-Reported through Interviews				X
		Asthma Attacks	Self-Reported through Interviews				X
		Cold/Flu Instances	Self-Reported through Interviews				X
		Attendance at On-Site Programs	CHH Tracking			X	
	Resilience to Extreme Weather	Heat-related Thermal Stress	Temperature and Humidity + Self-reported through perceived comfort surveys		X		X
		Cold-related Thermal Stress	Temperature and Humidity + Self-reported through perceived comfort surveys		X		X
		Power Outages	CHH Tracking			X	
	Well-being and Community Integration	Use of Transit vs. Car	Self-Reported through Interviews				X
		Walkability to Key Services and Amenities	Self-Reported through Interviews				X
		Perception of Community Cohesion	CHH Tracking and Interviews			X	X
		Participation in Programming	CHH Tracking			X	
Safety and Security	Life Safety	Home Fires	CHH Tracking			X	
		911 Police Calls	CHH Tracking			X	
		911 Fire Calls	CHH Tracking			X	
		Sense of Safety	Self-Reported through Interviews				X
	Mobility	Accessibility in Suites	Self-Reported through Interviews				X
		Accessibility in Common Areas (Indoor and Outdoor)	Self-Reported through Interviews				X
Comfort	In-Suite Comfort	Outdoor Noise Disruptions	Self-Reported through Interviews				X
		Indoor Noise Disruptions	Self-Reported through Interviews				X
		Thermal Controls	Number of Times Windows Opened // Thermostat Adjustments // Ceiling Fan Use // Ventilation Rates // Self Reported through Comfort Survey		X		
		Auxiliary Heating / Cooling devices	Metering of additional heating or cooling units // Self Reporting through comfort survey		X		
		Indoor Air Quality	VOCs // PM2.5 // PM5 // CO2 // Humidity + Temperature // Self Reported through comfort survey		X		
		Suite User Experience	Self-Reported through Interviews: Thermostats, appliances, windows, fixtures, odours - ease of use? Education / training required?				
	Building-Wide Comfort	Elevator Breakdowns	CHH Tracking through Maintenance Log			X	
		Corridor Air Quality	VOCs // PM2.5 // PM5 // CO2 // Humidity + Temperature // Self Reported through comfort survey		X		
Operations and Maintenance	Reliability	Material Durability	Maintenance Request Log			X	
		Equipment Maintenance	Equipment Breakdowns // Maintenance Calls			X	
		Appliance Maintenance	Maintenance Request Log			X	
		Warranty Calls	CM Warranties // Manufacturer Warranties			X	
	Pests	Pest Control Issues	Maintenance Request Log			X	
	Tenancies	Tenant Issues Related to Passive House	Self-Reported through Interviews				X
		Tenant adaptation and impact in retrofit	Completion of baseline 'entry survey' and follow up after set periods of time.				X
		Turnover	CHH Tracking			X	
	Resiliency in Performance	Comparison to Modelled Performance	Weather Data // PHPP Energy Model // Measured Heating and Cooling Demand		X		
		System Efficiency	Metering of central systems (pumps, boiler, flow rates and temperatures)		X		
		Working as Expected	In-Suite Ventilation Rates // In-Suite Temperature Levels		X		
		Commissioning	Controls Optimization	X			
Environmental Impact	Water Utility Savings	Water Volume / Month and Year	BAS Flow Meter on Utility Meter	X			
	Electricity Utility Savings	kWh/m2/yr	BAS Connection to Main Electrical Meter	X			
	Gas Utility Savings	kWh/m2/yr	BAS Connection to Gas Meter	X			
	Overall Energy Intensity	kWh/m2/yr	Calculated Based on Above Results	X			
	Avoided GHG Emissions	Tonnes CO2/yr	Calculated Based on Above Results	X			
	Embodied CO2 / GHGs avoided	Tonnes CO2	LCA Analysis Based on BIM Model		X		
Economic Impact	Affordability	Ability to Pay Rent	CHH Tracking			X	
	Site-Specific Impact	Property Value	Assessed Value	X			
		Rental Income	CHH Operating Data			X	
		Operating Costs	CHH Operating Data			X	
		Capital Cost vs Replacement Cost	Post-Construction Assessment				X
		Impact on Reserve Fund Planning	CHH Operating Data			X	
	Local Market Impact	Local Jobs Created or Maintained	Post-Construction Assessment				
		Skills Development and Trades Training	Post-Construction Assessment				X

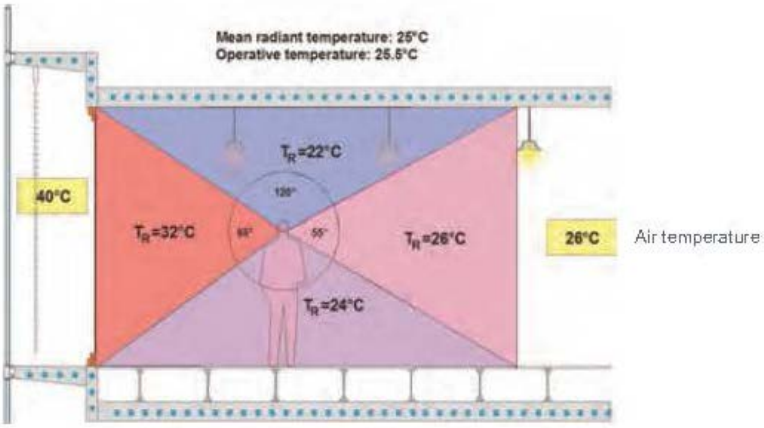
Operative Temperature vs. Air Temperature

Thermal Comfort

What we experience and perceive as thermal comfort in a building is influenced by both the air temperature and the mean radiant temperature. The mean radiant temperature accounts for the temperature of the surfaces to which a person is exposed. Balancing the operative temperature can create more comfortable spaces in a building.

The examples to the right illustrate the importance of balancing the operative temperature and not just the air temperature. People would feel the same level of comfort in both cases. Even though the air temperature in the example in the bottom right is warmer (26°C) than the example in the top right (24 °C), their operative temperature is around the same (25.5 °C). In the first example, since the surfaces are warmer, the air temperature needs to be cooler to provide the same level of comfort as the bottom room.





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Tower Neighbourhood Renewal
Toronto, Canada

Thermal Studies
26 August 2016

REPORT

Dynamic Thermal Comfort Modelling, Extreme Weather Days, Transsolar

c. This approach would allow CHH and CMHC a high degree of certainty that the project is functioning as designed throughout the building and also provide enough comparable data to produce comparisons and papers to share publicly.

3. Comprehensive
   a. Full coverage of all suites, corridors and common areas in the building
   b. This approach would allow for all suites to be measured, providing extensive monitoring and comparable metering throughout the whole building.
   c. This approach is exhaustive and provides the most usable data should CHH or CMHC wish to do detailed reporting, academic journals, or proposals for future projects.

It is the team's expectation and recommendation that the scientifically valid approach be used with as many suites measured as possible in order to provide as much comparability as possible.

MILESTONES

The study will be collecting data continuously, but will assemble results for reporting purposes at the following milestones:

- Pre-Occupancy: Sensors are installed, documented and commissioned. CityHousing Hamilton staff are trained on their use and maintenance. Materials will be developed for participant information (see engagement plan below).
- Six months post-occupancy: This analysis will capture early indicators of balancing and commissioning challenges. It is not typical for a building to meet its energy targets in the first year, due to ongoing commissioning. This first year will also indicate areas where training or education is required, related to central BAS, suite-scale systems, or components. This provides operators with an opportunity to make adjustments to recalibrate.
- One year post-occupancy: This analysis will capture a full year of seasonal impacts on the building performance and provide further opportunities for calibration of systems. In high-performance buildings, it is possible to improve performance by up to 100% by reviewing the first year of monitoring and verification.
- Two years post-occupancy: The second year of data collection is expected to meet or exceed energy targets. This analysis allows for one year of data to be collected following the initial adjustment and acclimatization year.

NON-ENERGY BENEFITS EVALUATION APPROACH

The non-energy benefit evaluation plan for the Ken Soble Tower aims to track the social, health, economic and general well-being impacts of the renewal project. These types of benefits have tremendous value for individuals, housing providers and public policy, but are less commonly tracked than energy benefits.

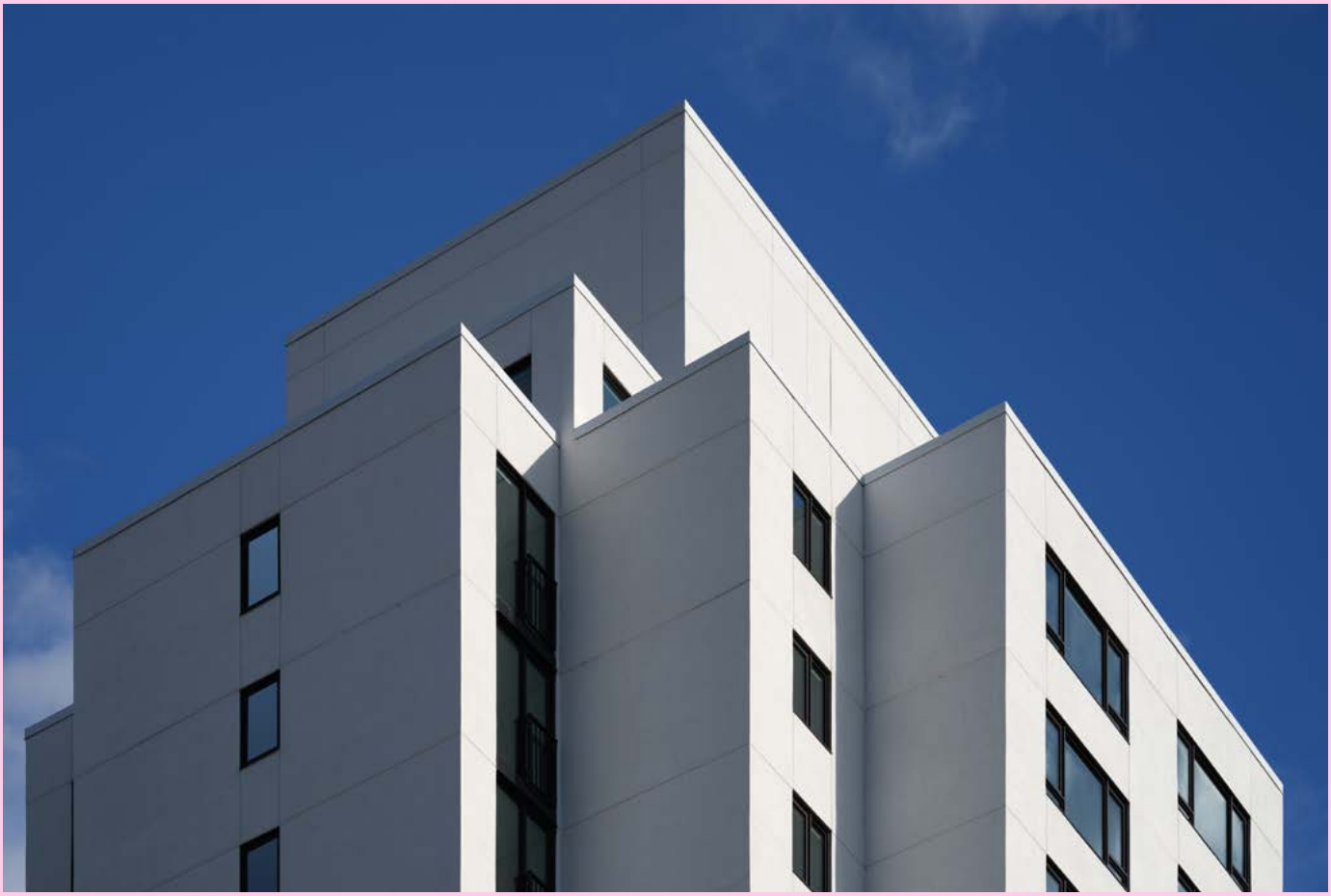
Through a program of institutional data collection, surveys and interviews, this study will gather a range of data that will be used to (a) develop educational material that helps residents and other key stakeholders 'acclimatize' to the renewed building; and (b) tracks and analyzes both resident experience of the building and metrics related to social and economic benefits.

The Ken Soble Tower has been unoccupied for several years, and its tenancy profile will be changed from single-occupants to senior-occupants following the renewal project. As such, for most metrics, it will not be possible to directly compare non-energy benefits before and after construction. For each dataset related to tracked metrics, the evaluation team will determine the most appropriate baseline: Compared to similar buildings in the CityHousing portfolio? Compared to other seniors' housing facilities in the CityHousing portfolio? The evaluation team will also analyze the likely impact of the renewal on the outcomes observed.

SCALE OF NON-ENERGY BENEFITS STUDY

1. Minimal
    a. A group of 7-10 residents and the building manager are engaged three times over a one-year period, with the first engagement taking place pre-occupancy.
    b. Results of each data collection and engagement are analyzed and building-wide communications and operational adjustments are made.
2. Scientifically Valid
    a. A group of 15-20 residents, the building manager and CityHousing facilities and management stakeholders are engaged every three months over a one-year period, with the first engagement taking place pre-occupancy.
    b. Most engagements take place via surveys, with at least 3-5 interviews in each round of engagement.
    c. Results of each data collection and engagement are analyzed and an educational program is shaped to respond to the results, including a variety of modes of communications to residents, staff training, and operational adjustments.

3. Comprehensive
    a. A group of 20 residents, the building manager and CityHousing facilities and management stakeholders are engaged every three months over a one-year period, with the first engagement taking place pre-occupancy. Neighbourhood surveys are also completed.
    b. Most engagements take place via interviews, with at least 15 interviews in each round of engagement. Some surveys may be collected to support the interviews.
    c. Results of each data collection and engagement are analyzed and an educational program is shaped to respond to the results, including a variety of modes of communications to residents, staff training, and operational adjustments.



ERA Architects

MILESTONES

The study will be collecting data continuously, but will assemble results at the following milestones (with number of milestones varying based on the scale of study selected):

- One month pre-occupancy: This analysis will capture stakeholder expectations and preconceptions of living and/or working in the renewed building. Given the high profile of the building and varying levels of understanding of the Passive House standard, this will provide baseline data as a point of comparison.
- Three months / six months post-occupancy: These analyses will capture early impacts and outcomes which may be heavily influenced by (1) acclimatizing to the building, and (2) a period of ongoing commissioning and adjustment to ensure the building is operating smoothly. The feedback and education layer of the evaluation will be extremely important in this phase: if residents are feeling hot in shoulder seasons, for example, a communication about how to bring cool air into suites may result in improved outcomes in the next data collection phase.
- Nine months / one year post-occupancy: These analyses will capture more stable data which can be used to report on the long-term outcomes of the renewal project against social and economic objectives.

ENGAGEMENT STRATEGY

Engagement Strategy

Providing residents with regular, transparent and open touch-points throughout the duration of the study will be critical to its success. The following framework is recommended for engagement of participants:

- Prior to occupancy, all future residents are contacted with information about the study, what it is aiming to achieve, and why they could be crucial to its success. It is recommended that partnerships with tenant advocacy groups or program partners be developed to provide cross-organizational support for the project and to build trust.
- Interested residents can self-select to be part of the study. CityHousing, working with the evaluation team, may opt to recruit known leaders as well. This core group of study participants will also be advocates and disseminators of information to their neighbours throughout the study, so strong leadership will be an asset.
- A kick-off meeting for study participants will allow future residents to meet one another, as well as providing information on the terms of reference, fielding questions and concerns, and discussing next steps. Based on the experience of The Atmospheric Fund (TAF) at their Toronto Community Housing monitoring study sites, information about confidentiality and the nature of the information being gathered will be of paramount importance at this stage. This engagement program will build on TAF's experience.
- A pre-occupancy survey or interviews (see scale of study section above) will be conducted with all participants.

- Regular post-occupancy engagements (at intervals determined by the scale of study selected) will take the form of a combination of individual interviews, group meetings, and surveys.
- A study wrap-up meeting will be held in which preliminary findings are shared with the participating residents prior to publication, as partners in the study. Any final observations or comments from the group can be integrated at that time.
- If at any time participants choose to drop out of the study, efforts will be made to recruit a new participant to take their place.

Privacy Considerations

Further to the above, a number of privacy considerations must be taken into account as part of the study. This information, along with consent forms, will be provided to all participants at the outset of the program. These relate to the following:

- Data storage location: Data to be stored at site on the building (if using local software), or stored on the cloud with an encrypted password-protected system.
- Anonymizing data: Data labelling will be anonymized such that results are not directly attributable to the suite being monitored. For example, if Suite 204 is being studied, this may receive a label such as unit ZA9. A key stored separately from the data will link the label to the unit, but otherwise only generic information such as suite type and orientation would be available.
- Granularity of information: For gathering purposes, very detailed information will be received, potentially at 5-10 minute intervals. The goal with this granularity will be to analyse behaviours such as window openings, fan usage, thermostat operation based on indoor conditions. While this level of detail is important for analysis, reporting information would carry only highly anonymized data, bundled into groups (by suite orientation and quadrant of building, for example).

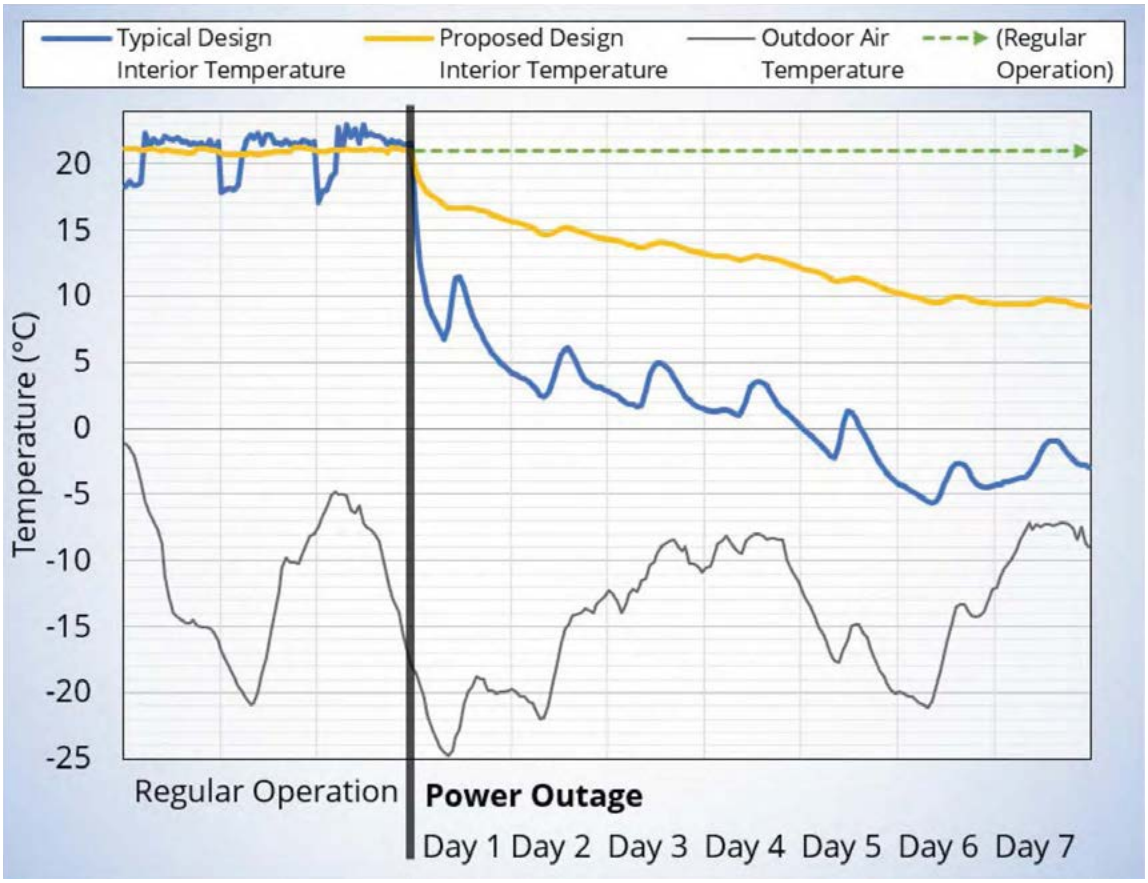
ADVISORY PANEL AND PARTNERSHIPS

An advisory panel has been convened to provide peer review and support on the Ken Soble monitoring and evaluation plan. This advisory panel has provided review to ensure the plan is (a) in line with industry standards, (b) builds on the experience and lessons learned by other organizations, and (c) allows for a uniform evidence base to be developed across this and other projects.

Organization	**Area of Expertise**
The Atmospheric Fund	Monitoring in post-retrofit apartment housing
University of Toronto, Department of Civil Engineering	Monitoring in post-retrofit apartment housing
University of Toronto, Sustainable Built Environment Performance Assessment (SBEPA) Research Network	Post-occupancy social benefits evaluations
Transsolar KlimaEngineering	Monitoring and verification procedures and methodologies
Pembina Institute	High performance building case studies

Focus on Impact: Passive Survivability

Building in resilience to extreme weather through a highly insulated building envelope. If power were lost in winter, the building's envelope would retain enough heat to allow residents to shelter in place for up to four days. By comparison, a building built to the Ontario Building Code requirements would need to be evacuated within four hours.



Resilience to Extreme Climate Events, Union Gas Savings by Design

Focus on Process: Design by Workshops

A collaborative approach to design brings all stakeholders together periodically to allow for cross-pollination of ideas, strategic problem-solving, and peer input. Throughout the Ken Soble design and implementation phases, a number of workshops were held which drove forward the design. These included early design charrettes with all disciplines, stakeholder workshops including a range of facilities and development partners from CityHousing Hamilton, a peer review charrette involving 12 peer experts organized by Union Gas, and workshops with the Construction Manager and trades.

Union Gas Workshop at ERA Architects

11. SCALING UP

The Ken Soble Tower transformation is indeed a showcase project, with learnings from its execution poised to inform retrofits across the country. The Tower Renewal Partnership has estimated that there are 777,100 households living in post-war apartment towers across Canada. If each of these towers were to undergo a retrofit as ambitious as the Ken Soble tower, the national impact would be tremendous: 777,100 affordable homes would be saved from loss due to deterioration or gentrification, and nearly three megatonnes of carbon emissions would be averted. But this scaling will require shifts to support the retrofit economy. Key recommendations that can help to spur this growth are as follows:

1. **Owners require support to take on projects of this scale:** Most housing providers are expert asset managers without expertise in complex construction. Help public sector and non-profit owners to build their capacity to take on retrofit projects through sector-specific supports such as financial guidance and retrofit best practice guides. Provide clear technical and best practice guidelines for retrofits for owners, including guidance on phased retrofit approaches to avoid locking in carbon, for those who cannot afford to undertake large projects all at once.

2. **Support owners in engaging their tenants:** Nearly all projects which implement retrofits will have tenants in place during construction. Provide guidance documents on minimizing tenant disruption to owners undertaking retrofits with residents in place and assign budgets to these activities, which should be eligible for funding support.

3. **Help build knowledge among design professionals:** Scaling of

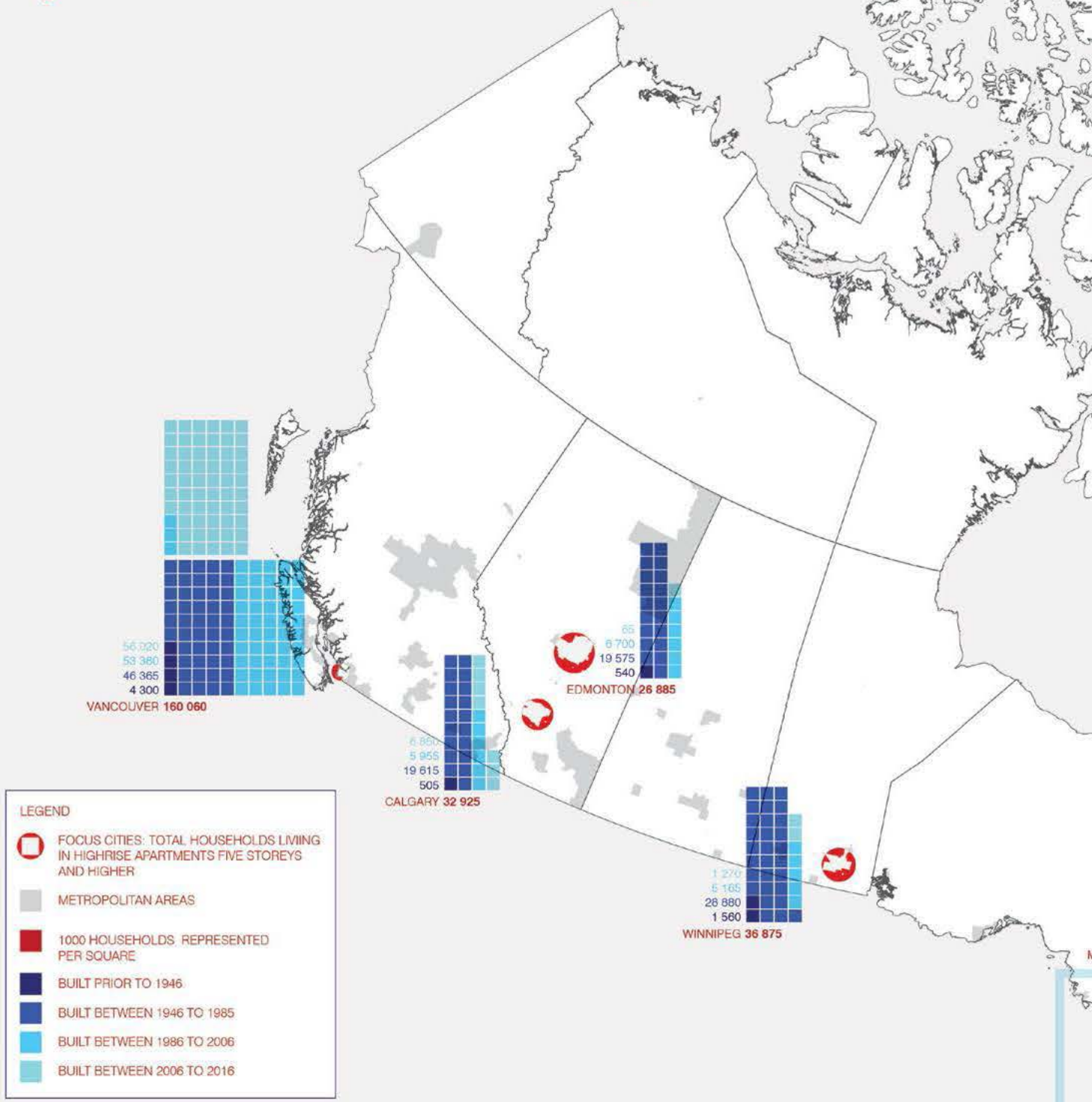
deep retrofits requires a nation-wide capacity among architects and engineers. Provide specialized training and certification for retrofit and high-performance design, and support colleges and universities to develop high-performance building labs that offer ongoing training for tradespeople, architects and engineers. Create demonstration centres as knowledge-dissemination hubs for information, training, product and methodology showrooms, and other supports for high-performance new-builds and retrofits.

4. **Expand the retrofit supply chain:** The retrofit ecosystem must become faster, better and cheaper. Much of this innovation will begin in the supply chain. Encourage Canadian manufacturers to compete to address enhanced performance goals through new product development incentives and competitions. Support and develop demonstration centres for proof-of-concept, product testing and cross-industry education and training.

5. **Support capital repair work when bundled with energy and accessibility targets:** As evidenced at Ken Soble, the majority of the costs associated with deep retrofits will often be in the 'enabling works', which are capital repairs: structural repair, ventilation upgrades, plumbing distribution failures and elevator modernizations are just some of these costs which have tremendous impacts on housing quality but are not tied to funding dollars. Allow publicly-supported carbon-reduction-driven retrofits to be bundled with capital repairs to encourage more holistic projects which impact housing quality.

CANADIAN HOUSEHOLDS LIVING IN HIGHRIS BUILDINGS (FIVE STOREYS AND HIGHER)

By Period of Construction, 2016



TOWER RENEWAL PARTNERSHIP

NEIGHBOURHOOD CHANGE & Building Inclusive Communities From Within

UNIVERSITY OF TORONTO

SOURCE: STATISTICS CANADA, CMA DATA, CENSUS 2006/2016

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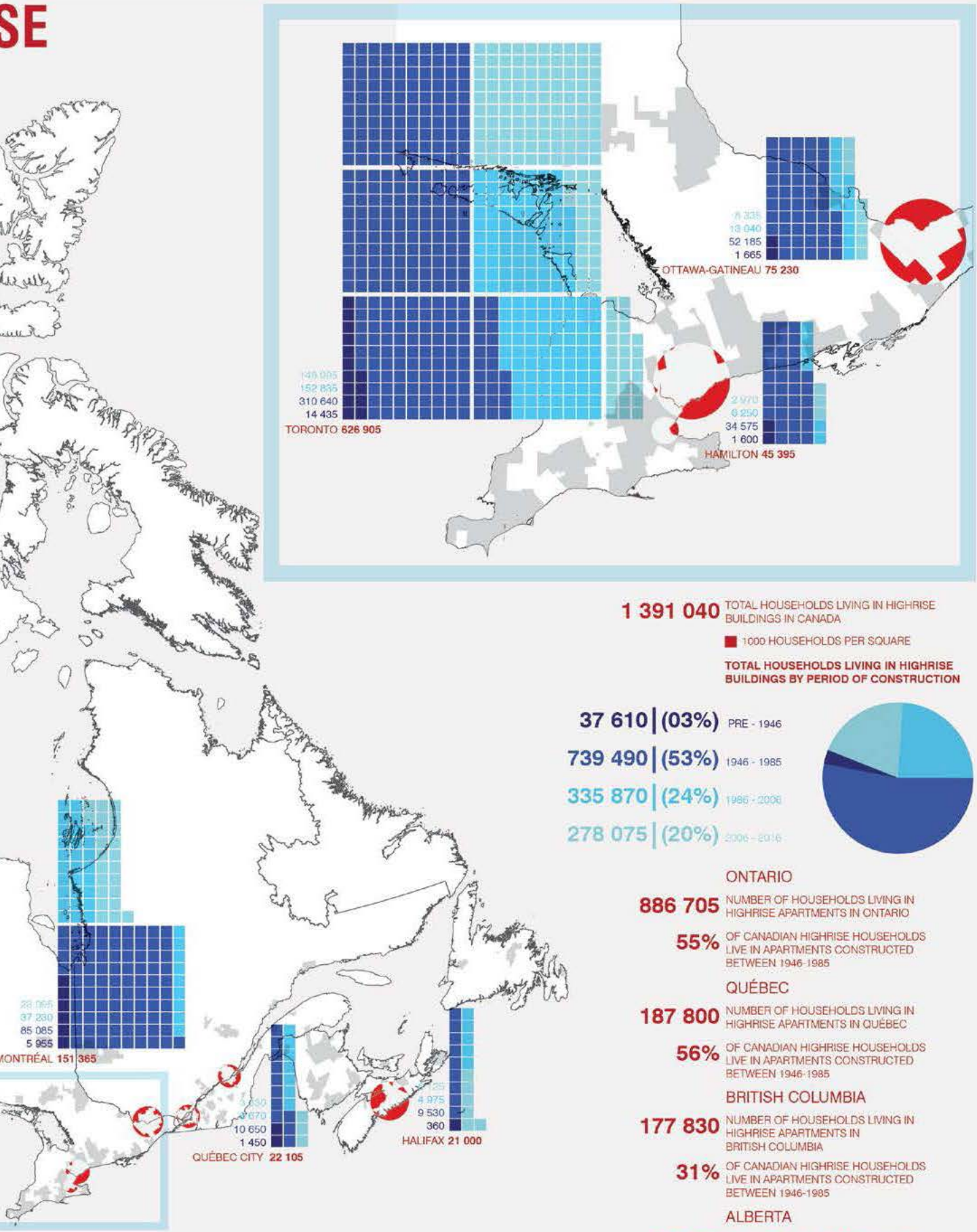

1 391 040 TOTAL HOUSEHOLDS LIVING IN HIGHRISE BUILDINGS IN CANADA

1000 HOUSEHOLDS PER SQUARE

TOTAL HOUSEHOLDS LIVING IN HIGHRISE BUILDINGS BY PERIOD OF CONSTRUCTION

37 610 | (03%) PRE - 1946

739 490 | (53%) 1946 - 1985

335 870 | (24%) 1986 - 2006

278 075 | (20%) 2006 - 2016

ONTARIO

886 705 NUMBER OF HOUSEHOLDS LIVING IN HIGHRISE APARTMENTS IN ONTARIO

55% OF CANADIAN HIGHRISE HOUSEHOLDS LIVE IN APARTMENTS CONSTRUCTED BETWEEN 1946-1985

QUÉBEC

187 800 NUMBER OF HOUSEHOLDS LIVING IN HIGHRISE APARTMENTS IN QUÉBEC

56% OF CANADIAN HIGHRISE HOUSEHOLDS LIVE IN APARTMENTS CONSTRUCTED BETWEEN 1946-1985

BRITISH COLUMBIA

177 830 NUMBER OF HOUSEHOLDS LIVING IN HIGHRISE APARTMENTS IN BRITISH COLUMBIA

31% OF CANADIAN HIGHRISE HOUSEHOLDS LIVE IN APARTMENTS CONSTRUCTED BETWEEN 1946-1985

ALBERTA

62 395 NUMBER OF HOUSEHOLDS LIVING IN HIGHRISE APARTMENTS IN ALBERTA

66% OF CANADIAN HIGHRISE HOUSEHOLDS LIVE IN APARTMENTS CONSTRUCTED BETWEEN 1946-1985