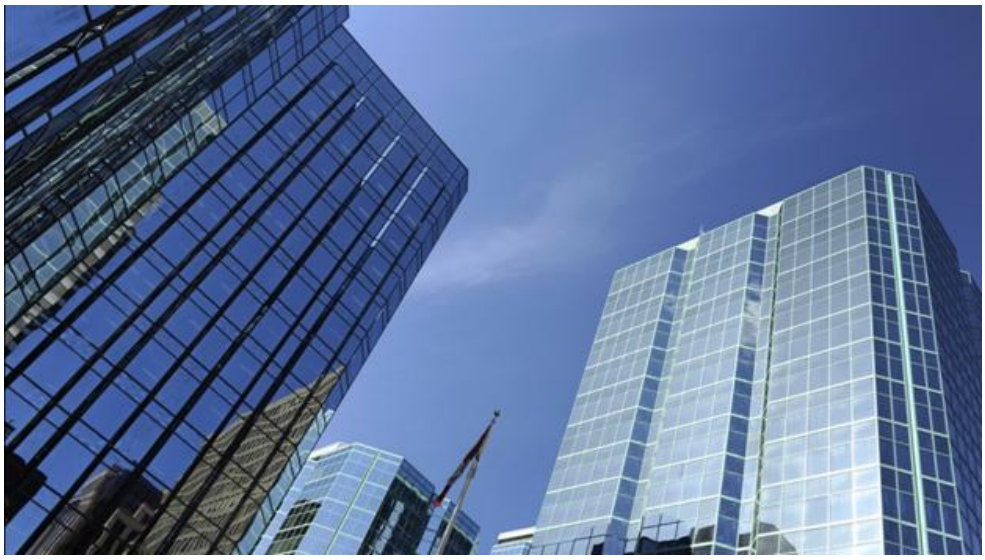

BETTER BUILDINGS OTTAWA

Commercial Building Benchmarking and Auditing Program

Climate Change and Resiliency Section,
City of Ottawa

Sept 15, 2021

BetterBuildings OTTAWA

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1. Executive Summary

This Better Buildings Ottawa Benchmarking and Auditing program involves six steps.

- *Step 1: Retrofit Roadmap* - define the deep energy reduction pathways for different vintages of commercial buildings and multi-unit residential buildings (MURBs) and to set target energy and emissions performance thresholds for each archetype of building considered.

- *Step 2: Benchmarking and Transparency of Energy and Emissions* - recruit and support commercial buildings to benchmark and disclose their energy and emissions performance for transparency to tenants and the public. Provide each with an energy scorecard that identifies opportunities for energy and emissions reductions.

- *Step 3: Thermal Audits of Buildings* – Publish street level thermal scans reports of the facades of commercial buildings and MURBs in dense areas. Offer subsidized full thermal audits of buildings with the best opportunity to reduce emissions through building envelope upgrades while resources last.

- *Step 4: Capacity Building* – with partners, host learning opportunities on building retrofit strategies, embodied carbon, shadow carbon pricing, carbon budgeting, sustainable commuting, and sustainable procurement. Subsidized training will be provided to contractors and trades.

- *Step 5: Development of an Amalgamation and Financing Program* – develop a financing program and amalgamation strategy. Leverage the cohort of investment-ready building owners to develop an amalgamated portfolio of buildings to secure favourable financing terms.

- *Step 6: Development of an Energy Community Improvement Plan* - develop an energy CIP to encourage deep energy and emissions reductions.

This program will develop a cohort of large commercial buildings or multi-unit residential buildings (MURBs) in Ottawa all working towards the common goal of benchmarking and reducing energy consumption and emissions. Program participants will benchmark their energy consumption and greenhouse gas emissions publicly. In exchange, participants will receive subsidized thermal audits, capacity building workshops, and collaboration opportunities. The program is designed to enable energy cost reductions, health and productivity improvements, and greenhouse gas reductions in commercial buildings and MURBs in Ottawa. Similar benchmarking programs across the continent have shown annual energy consumption drops of 2%[1].

[1] file:///C:/Users/ashworthja/Downloads/IMT%20Benchmarking%20Matrix%20Feb%202021.pdf

This program will test how municipalities can catalyze building envelope improvements by providing street view thermal imaging reports and offering subsidized comprehensive thermal audits. It will help determine which building archetypes require building envelope upgrades to meet the GHG targets in Ottawa.

Through the use of combined virtual audits based on utility data and the street view thermal scans, the City will assess the opportunity to create energy performance labels for buildings using street view thermal scans alone. This will enable rapid uptake of labeling without access to utility data, which the municipality does not have for buildings not reporting through the provincial benchmarking program (compliance rate in Ottawa for the provincial program is less than 50% currently). These labels will inform thresholds for possible future energy performance bylaws.

This program will assess how the City can utilize Community Improvement Plans to encourage energy and emissions reductions in buildings. Finally, it will test how a municipality can play the role of amalgamator for securing favourable financing terms for private building owners.

Large and medium-sized office buildings (greater than 20,000ft^2) will be the initial focus for the program as they are the most numerous building type, are currently empty, and undergoing restructuring for the post-pandemic reality, presenting an opportunity to add energy conservation measures. There are more than 540 such office buildings in Ottawa, with an average size of 75,000ft^2. MURBs will also be included in the program, as they also benefit from thermal upgrades and will need to follow similar implementation pathways to decarbonization.

The City is dedicating $122,900 towards this program, plus staff time of some existing employees valued at $53,393. Program delivery partners will contribute in kind to the program, totaling an additional $30,000. An application has been submitted to the Federation of Canadian Municipalities for an additional $175,000. The program will initially be offered over one year.

Benefits that we can expect from this program to the regional economy can be summarized as follows:

- Enable buildings to be investment-ready
- Create green tech jobs
- Improve employee productivity and retention as well as increasing building asset value
- Build on high-tech expertise for smart tech solutions
- Attract new types of business to the region
- Help businesses recover from the pandemic
- Transparency to tenants and improve energy literacy
- Avoid future costs from damage from extreme weather
- Avoid future cost associated with rising carbon costs

Retrofits quantified though this program are expected to average $5.4 million per building. Approximately three hundred buildings will receive street view thermal audits to encourage them to start down the path of deep energy retrofits. Typically, buildings implement the measures over many years, so if 25% of the measures are implemented in half of the buildings, or 150, during the program term, this represents $202 million and another $608 million after the term.

Building retrofits provide the most significant job creation opportunity identified in the Energy Evolution Strategy, with 8,899 person-years of employment projected between 2021 and 2041, which equates to 444 jobs for the 20-year period. These new jobs will be predominantly positions in skilled engineering, green tech, and trades.

Improving building space by making it more energy efficient will have a co-benefit of improving thermal regulation, ventilation, occupant comfort, productivity, and ultimately asset value. Literature suggests that, by making commercial buildings more energy efficient, property values will increase by 10 to 25 percent[2], which will, in time, provide a revenue stream to the City which could be used for further climate change programs.

2. Background

In April 2019, Council declared a climate emergency which provided direction to staff for expanded work on the Climate Change Master Plan, Energy Evolution, and the future Climate Resiliency Plan.

2.1 Climate Change Master Plan

January 2020, Ottawa City Council approved a new Climate Change Master Plan and set new targets to reduce community greenhouse gas (GHG) emissions 100% by 2050 and corporate emissions 100% by 2040. These targets are in line with the Paris Accord and the federal government targets. One of the eight priorities of the Climate Change Master Plan was to develop and implement the Energy Evolution Strategy, which sets a framework for meeting the GHG emissions reduction targets.

2.2 Energy Evolution Strategy

In October 2020, Council approved the Energy Evolution Strategy. Energy Evolution is a carbon reduction plan designed to manage energy consumption, promote the use of renewable energy, and advance local economic development opportunities in Ottawa. Developed in collaboration with almost 200 public and private stakeholders representing 90 organizations, Energy Evolution is a community-wide initiative with a vision to transform Ottawa into a thriving city powered by clean, renewable energy.

At the core of Energy Evolution is a comprehensive, custom-built energy, emissions, and finance model. The model incorporates growth, land use, buildings, transportation,

[2] IMT *Energy Benchmarking and Transparency Benefits* https://www.imt.org/wp-content/uploads/2018/02/IMTBenefitsofBenchmarking_Online_June2015.pdf

and waste data with energy conservation, efficiency, and renewable energy pathway studies and presents two GHG emission scenarios:

- A Business-As-Planned scenario (BAP scenario)
- A 100% by 2050 target scenario (100% scenario)

The BAP scenario is a projection from today until 2050. It is designed to illustrate the anticipated energy use and emissions in Ottawa if no additional policies, actions, or strategies are implemented beyond those that are currently underway or planned. The 100% scenario describes the scope and scale of change required for Ottawa to align with the IPCC target to limit global warming to 1.5ºC and reduce emissions by 100% by 2050. It also identifies what is thought to be the most cost effective and plausible path forward to meeting Council's GHG reduction targets.

As shown in Figure 1, reductions from the BAP, which is depicted as the thin orange line across the top, requires significant action in 5 different sectors: electricity, transportation, waste and renewable natural gas, existing buildings, and new buildings.

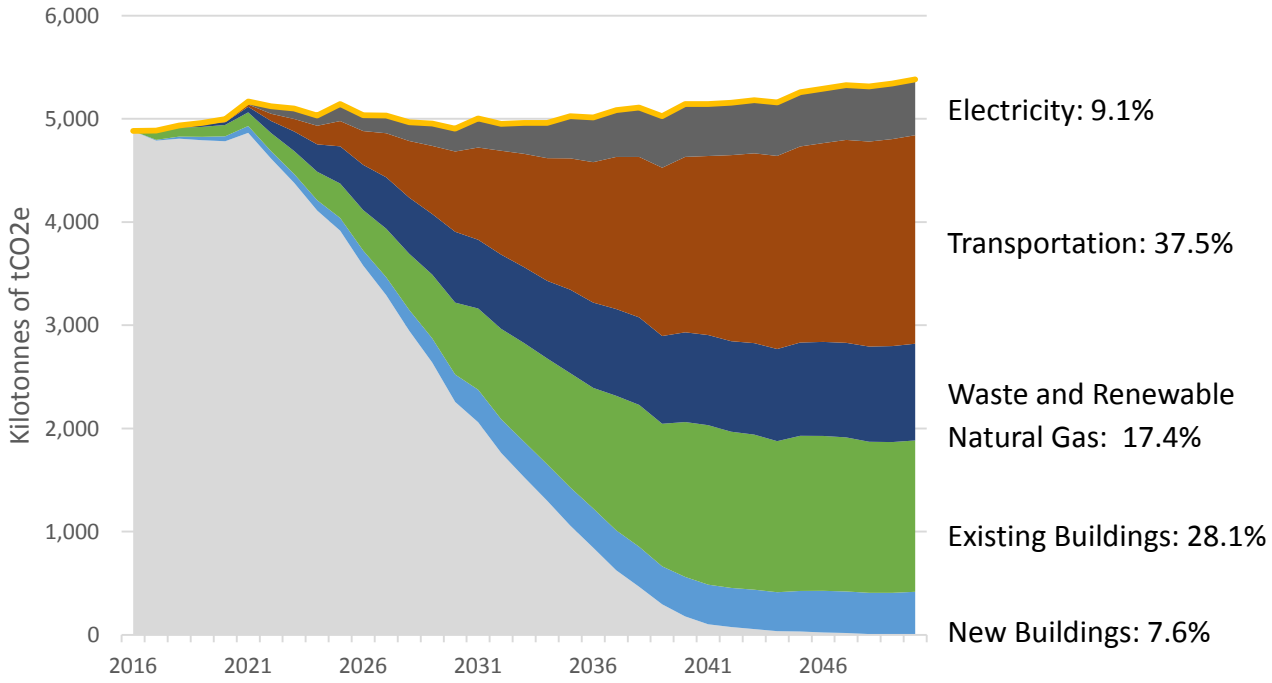

Figure 1 Projected community wide GHG emission reductions by sector to achieve the 100% scenario

In the Energy Evolution Strategy, under the 100% Scenario, existing buildings are projected to provide 28% of the GHG reductions by 2050. As part of the Energy Evolution status update Council received in January 2020, staff identified 20 priority projects to advance Energy Evolution. One of the projects was a Commercial Building Retrofit Accelerator Strategy to accelerate Part 3 building retrofits through marketing, information and financial mechanisms. Local Improvement Charges (LICs) and

Community Improvement Plan (CIPs) were identified as a sub-component of the Commercial Building Retrofit Strategy and included as a separate projects in the Energy Evolution Strategy.

In 2019, Industrial, Commercial, and Institutional buildings and large apartments contributed 22% of the community-wide GHG emissions[3]. Together, these building types, which all fall under Part 3 of the Ontario Building Code, are the focus of the Commercial Building Retrofit Accelerator Strategy.

The emissions reduction curve for Part 3 buildings in Figure 2 shows the annual reductions required. It also shows that building retrofits need to be almost complete by 2040. This emissions curve includes building envelope retrofits as well as heat pumps. It demonstrates that retrofits of large commercial buildings (>20,000ft^2) including offices are the most significant source of GHG reductions, more so than small commercial buildings and apartments.

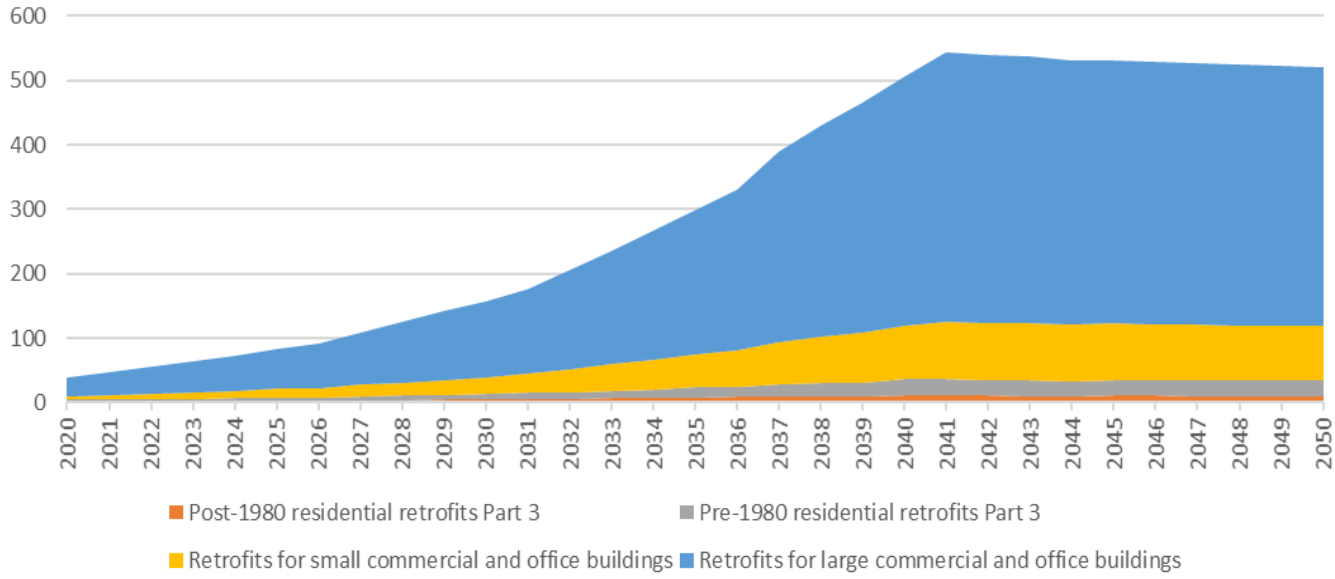

Figure 2 Emissions reduction profile for Part 3 building retrofits

Data available from the provincial Energy and Water Reporting and Benchmarking program, which requires all buildings greater than 100,000 ft^2 report their energy and water use, shows that office buildings in Ottawa consume the most energy and emit the most green house gases (GHGs) of all large building types in Ottawa (see Figure 3). As such, they are the focus for this program.

[3] City of Ottawa's 2019 GHG Inventory

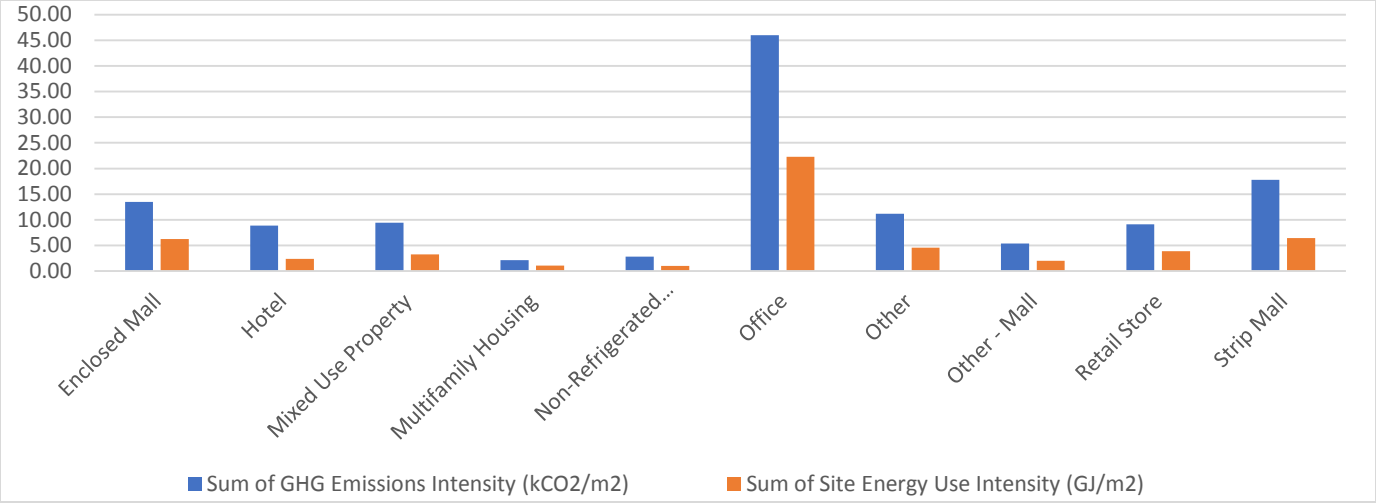

Figure 3 GHG emissions from commercial buildings in Ottawa >100,000ft^2

Although there is a provincial program requiring benchmarking of energy and emissions performance of all buildings over 100,000ft^2, compliance rates in Ottawa are less than 50%. Additionally, that program only releases the data in aggregate. It does not provide transparency to tenants, prospective buyers, or the public. This program makes the assumption that, in order to increase awareness and shift behaviour, making building energy and emissions performance available at the address level is a necessary first step. Coupling that with thermal imaging of the facade from the street level is expected to be a cost-effective way to drive uptake (a picture is worth a thousand words) and inform energy labeling of buildings.

2.3 Commercial Building Retrofit Accelerator Strategy

A Commercial Building Retrofit Accelerator Strategy, one of the 20 priority projects of Energy Evolution, outlines the steps required to retrofit almost all of the industrial, commercial, and institutional buildings in Ottawa by 2050 (as per the Energy Evolution model). It lists six important steps as well as the role for the municipality in each. These steps include:

1. Retrofit roadmapping
2. Benchmarking and transparency
3. Marketing, education, and training
4. Supporting accelerated retrofits with economic tools and coordination
5. Regulate energy audits and energy retrofit standards
6. Senior Government Engagement

Steps 1 and 6 will be undertaken by staff simultaneous to the launch of this program. This program focuses on steps 2 and 3. All of these steps prepare the way for the introduction of and LIC and CIP program, which would fall under step 4 of the Better Buildings Ottawa Strategy. Data collected from this Program and the subsequent steps will also support the development of future regulations and retrofit standards.

2.4 Municipal Financing Program

Municipalities have access to long term, low interest borrowing. By providing this through to private building owners, municipalities can help to increase uptake of energy retrofits. There are various ways this can be achieved, such as a municipally owned energy service company, a municipal loan guarantee, or a Local Improvement Charge mechanism.

Through a financing program, municipalities can:

- Enable property owners to improve the comfort and environmental performance of their buildings;
- Target areas in transition or in need of repair, rehabilitation and redevelopment;
- Support appropriate building upgrades through expert advice and oversight;
- Stimulate private investment in property upgrades that reduce energy cost exposure to residents and businesses; and
- Stimulate local job creation in the contractor, trades, and renovation sectors.

Existing financing programs have been successful by helping overcome some of the most significant barriers to deep energy retrofits of buildings including:

- Limited understanding of how energy efficiency affects real estate value;
- Limited knowledge and motivation to retrofit – A program would include expert advice and streamlining of the retrofit process;
- Access to long-term, fixed cost financing – Municipalities have access to fixed cost, long term financing that they can make available to building owners through a financing program. A program could also encourage private investors in energy retrofits by bundling portfolios of retrofits to achieve the scale of cashflow required by many private investors and by providing quality assurance; and
- Lock-in – By providing expert advice, the program can steer away from sunsetting technologies and fuels.

2.4.1 Local Improvement Charge Financing

One option for a municipal financing program involves leveraging the Local Improvement Charge (LIC) mechanism available to municipalities. Municipalities are uniquely able to offer financing tied to a property using this mechanism under the Municipal Act (2001). This mechanism is often referred to as Property Assessed Clean Energy, or PACE, in the United States. In 2012, the Ontario Ministry of Municipal Affairs and Housing authorized Ontario Regulations 322/12 and 323/12, amending O.Regs. 586/06 and 596/06 under the Municipal Act, 2001 to:

- Expand the uses to include energy efficiency, renewable energy and water conservation in alignment with municipal goals and policies;
- Remove the burdensome LIC set-up barriers since participation is voluntary;
- Remove the right to petition or appeal against or in favour of this type of LIC;

- Include a user-pay method that covers all municipal costs including marketing, interest, and administration;
- Include repayment to the municipality as a temporary charge on the property tax bill that stays with the property not the owner; and
- Allow the owner to make lump payments to clear the outstanding balance.

Participation is voluntary and only affects one property. To date, programs using LICs or similar mechanisms have been offered in 14 Canadian municipalities and 36 American states to finance green technologies or improvements in commercial buildings and more than $800 million in projects have been financed across the United States[4]. To date in Canada, Toronto is the leading jurisdiction in commercial LIC programs.

Experience in other municipalities has suggested that commercial LIC programs drive energy efficiency improvements of approximately 15 to 30 percent in participating building[5]. Although this is not enough to meet the 50 to 60 percent energy reduction target set for commercial buildings in Ottawa under the Energy Evolution Strategy, it is a good start that can be improved upon over time. The Canada Infrastructure Bank financing is available only where buildings achieve a 30% GHG reduction.

Specific barriers that an LIC program could help overcome include:

- Ownership term uncertainty and long payback period – Retrofits often have a 10 to 20-year payback period, so longer than some building owners expect to own their buildings;
- The split incentive problem. Since most commercial buildings use triple net leases where the utility bills and property taxes are paid for by the tenant, then tying the financing repayment obligation to the property tax bill overcomes the standard obstacle of the landlord having no incentive to improve energy efficiency (because they do not pay the utilities). Triple net leases are not often used in MURBs, however, so a different solution will be needed for apartments.

2.4.2 Energy Service Company Financing

Energy Service Companies (ESCos) have existed for many decades to offer both financing and project management services for buildings undergoing energy retrofits. They have historically been focusing on the public sector buildings, given the long term view and lower risk of default inherent in that sector. There may be ways that municipalities can help extend that model to private buildings through amalgamation, capacity buildings, and/or loan guarantees. Further analysis is required to determine

[4] https://www.energy.gov/eere/slsc/property-assessed-clean-energy-programs
[5] https://media.rff.org/documents/RFF-DP-10-16.pdf

the most effective way for municipalities to catalyze retrofits through innovative financing.

2.4.3 Measured Energy Efficiency Transaction Structure

Another mechanism that has been identified as an innovative financing approach for commercial buildings is the Measured Energy Efficiency Transaction Structure (MEETS). It has been used successfully in Seattle and is being replicated in other US jurisdictions. The approach is dependent on a utility (electricity or gas typically) to offer a purchase price for “nega-watts” or nega-therms” (electricity or gas savings). Then, an energy service company can invest in energy improvements in the buildings and be paid out of the metered savings. The City of Ottawa is exploring the possibility of such a financing mechanism with the municipally-owned electric utility to determine if provincial regulations allow for such a mechanism.

Given that:

- Significant energy and efficiency improvements in commercial buildings will be required to meet Ottawa’s GHG emission reduction targets;
- Municipalities are uniquely positioned to offer long term, low interest financing;
- Ottawa can access fixed rate, long term financing at better terms than is available in the private market; and
- Experience in other municipalities has demonstrated that financing programs have driven energy efficiency improvements and reduced barriers to energy retrofits for homeowners;

Staff will assess whether a commercial financing program is feasible for Ottawa. If it is found that:

- access to long-term, low interest financing is a limitation to deep energy retrofits of commercial buildings; and
- that an approach to financing can align incentives for landlords and tenants to perform energy retrofits;

then the City may pursue securing appropriate finance to develop a financing program. It may be determined to offer financing just for specific energy retrofit measures for which private financing is not accessible, such as building envelope improvements.

2.5 Community Improvement Plan

A Community Improvement Plan (CIP) is a mechanism to provide incentives to private building owners. The City has limited control over private property, but the CIP is one of the few municipal tools available to influence changes to private properties and associated buildings. CIPs are often applied in situations where building owners make changes to their buildings that increase the property value. A portion of the future cash flows earned by the City from the increased property taxes and the development charges are offered back to the building owner as an upfront grant. In this case, the

mechanism may be utilized to incentivize superior energy performance and deep energy retrofits.

CIPs provide a flexible, comprehensive, and strategic framework for municipalities in Ontario to provide incentives to property owners to improve their lands and buildings. Through CIPs, municipalities can:

- Focus public attention on local priorities and municipal initiatives;
- Target areas in transition or in need of repair, rehabilitation and redevelopment;
- Facilitate and encourage community change in a coordinated manner;
- Stimulate private sector investment through municipal incentive-based programs.

The City of Ottawa has several existing CIPs to date including one related to brownfield redevelopment. The brownfield CIP is expected to be updated in Fall 2021. This update may include proposals around energy targets to align with Energy Evolution. If an energy CIP is brought forward, it will provide clear guidance on relationship to existing CIP to ensure programs do not overlap or contradict each other.

Key aspects of the program to be explored include:

- A boundary area applying to the entire geographic area of Ottawa. The program may name added criteria for specific zones. For example, this could include district energy connection requirements;
- A focus on existing commercial and multi-unit residential buildings;
- GHG emission targets based on, building type, and other factors determined during program development;
- Support for changes to number of units and reduced overall dwelling size;
- Identification of opportunities to support projects which address related City objectives such as addition of affordable housing units; and
- Alignment with utility incentives and the High-Performance Development Standard to streamline administrative review and associated costs.

City staff will assess whether the property tax increase from energy retrofits is sufficient to justify a CIP, or if there are property improvement scenarios unrelated to the energy savings where there would be future cashflows that could facilitate a CIP.

2.6 Economic Development Strategy

Another relevant City document is the Economic Development Strategy which outlines the economic development priorities for Ottawa and lists the business sector as a key player. It also identifies environmental protection as an important element of business retention in Ottawa. The City of Ottawa's Economic Development Strategy will be updated in 2022 and climate change has been identified as a key priority for the new strategy.

Building retrofits present an opportunity to both reduce GHGs and create jobs to be explored in the new Economic Development Strategy. It has been found by the Conference Board of Canada and Finance Canada that every dollar invested in local

infrastructure boosts Canada's real Gross Domestic Product by $1.20–1.60.[2] As such, stimulating local investments into improving buildings in Ottawa is projected to have a ripple effect on the local economy.

3. Proposed Pilot Program

The Pilot Program will be implemented in six steps as outlined below.

3.1 Program Overview

- *Step 1: Retrofit Roadmap (Q3 2021)*

The first step to achieving this goal involves an analysis done by the City to define the deep energy reduction pathways for different archetypes and vintages of commercial buildings. This will be used to set target energy and emissions performance thresholds. This Roadmap will also involve modeling the financial impact on different building archetypes to inform where public funds will be needed in the future to achieve the GHG reduction targets and to protect those most vulnerable to energy poverty.

- *Step 2: Benchmarking and Transparency of Energy and Emissions (Q3 2021, Q1 2022, Q1 2023)*

The next step (recurring annually) will be to recruit and support Part 3 buildings to benchmark their energy and emissions performance publicly, for transparency to tenants and stakeholders. Recruitment will be a multi-pronged approach and will leverage the networks of existing organizations like BOMA, CaGBC, Hydro Ottawa, and EnviroCentre. All benchmarking buildings will receive an energy scorecard that identifies opportunities for energy and emissions reductions.

- *Step 3: Thermal Audits of Buildings (Q3 2021 – Q4 2023)*

To kick off the program, a street view thermal scan will be published in neighbourhoods of dense commercial buildings and MURBs, starting with Centretown and Kanata North. These are also the neighbourhoods of focus for Hydro Ottawa conservation efforts, so this program will expand upon Hydro Ottawa's outreach work. This scan will provide thermal images of the facades of buildings and an initial report of energy efficiency opportunities. Five buildings identified as most in need of building envelope improvements will be provided free, comprehensive thermal scans in exchange for sharing their data with the City. Others interested will have access to comprehensive thermal scans at a bulk rate by piggybacking on the City's procurement, which will reduce the cost by approximately 30%.

- *Step 4: Capacity Building (Q4 2021 – Q4 2023)*

The City will work with partners to deliver capacity building workshops. All participants will be invited to workshops on building retrofit strategies and common needs/opportunities for office buildings. Workshops will also be offered on other climate-related topics including shadow carbon pricing, embodied carbon, carbon budgeting, sustainable commuting, and sustainable procurement. Participants will be provided with networking opportunities and file sharing for accelerating innovation through collaboration. Online tools for capacity building, options analysis, and project implementation support will be developed. Opportunities for bulk grant funding

applications and procurement will be sought. Subsidized training for contractors and trades will be provided to expand the labour market.

- *Step 5: Development of a Financing Program (Q3 2021 - Q4 2023)*

To offer financing to for deep energy retrofits, a financing program will be developed along with an amalgamation strategy. This step will leverage the engagement of the Network participants to assess the best approach to financing. Network participants will be primed to form an amalgamated portfolio of buildings to secure favourable financing terms with lenders. The funders identified to date require investment portfolios of $30 million. A consultant may be hired to develop the financing program and amalgamation strategy.

- *Step 6: Development of an Emissions Community Improvement Plan (Q1 2022 - Q4 2023)*

The use of an energy CIP to encourage deep energy and emissions reductions of commercial buildings will be assessed. It will consider the effectiveness of incentives for building owners that meet the thresholds set in the Roadmap and for the measures that have been identified as needing subsidization to be financially viable.

3.2 Eligibility Requirements

Participation in the program is voluntary and owner-initiated. Eligibility requirements are as follows:

- Buildings over 20,000 ft^2
- Buildings willing to share their monthly energy and water consumption data from 2018 to 2020 and to publicly disclose their 2019-2025 energy consumption data publicly through Energy Star Portfolio Manager
- Buildings interested in participating in educational workshops, networking events, and collaboration opportunities.

3.3 Thermal Audits

Given that:

- utility programs have provided subsidized energy audits to the majority of buildings in the past 10 years;
- most energy audits for commercial buildings focus on mechanical and electrical systems and do not go into detail on the building envelope;
- the Energy Evolution model found that building envelope improvements would be needed in the majority of buildings to meet the GHG reduction targets;
- thermal scanning technology is increasingly accurate and affordable; and
- thermal audits can also identify structural issues that can trigger an envelope retrofit;

It was hypothesized that offering subsidized thermal audits would help move the industry towards deeper energy and emissions reductions.

Subsidized thermal audits will be provided to five buildings which, through the street view scans, show significant opportunity for GHG reductions through building envelope upgrades and are participants in the BBO program. These buildings will receive a free 3D thermal image of their buildings to assess the feasibility of building envelope improvements. Where possible, the thermal audits will also include information that will prepare the buildings for applications to funding sources.

In addition to the thermal audits, all participants will be offered an energy scorecard and virtual audit using data analysis that will allow for improved understanding of energy efficiency opportunities in the buildings and identifying possible collaboration opportunities with other participants.

3.4 Program Impact Measurement and Verification

The following indicators will be tracked to determine program success and to pivot program implementation techniques to improve impact:

- Numbers of buildings recruited to join the network
- Number of buildings that benchmark their energy performance publicly
- Number of thermal audits completed
- Number of virtual audits completed
- Number of participants to capacity-building workshops and breadth of representation
- Number of buildings implementing energy reduction retrofits (participants will also be asked to share data on the total value of retrofits)
- Energy and emissions savings as a result of retrofits
- When available, number of businesses accessing financing through the Local Improvement Charge mechanism

3.5 Program Risks

The main risks to program success include:

- Limited uptake from the target audience
- Office buildings have been vacant for almost a year and their revenues may have suffered as a result
- Requirements to add ventilation solutions may have added costs and reduced the offices' ability to finance additional work
- Street view thermal scans may not show enough retrofit potential and therefore not provide enough incentive to participate.
- Attention of landlords may be diverted due to public health priorities, so participation may be limited
- Inability to meet in person may limit collaboration and networking opportunities
- Securing multi-year funding may be difficult to ensure continuity of the program.

3.6 Program Budget

The City has allocated up to $440,000 through the 2019 Hydro Ottawa Dividend Surplus to support commercial retrofits, a Climate Ambassadors Network (being renamed the Better Buildings Ottawa Network), and the development of a CIP. By spending $122,900 of those funds, and by leveraging partners and funders, a total program budget of $351,293 can be provided, as shown in Table 1.

The cost to develop an online benchmarking tool, to provide energy scorecards, virtual audits, and thermal scans was determined through quotes from service providers. To determine the cost of the capacity building workshops, quotes from vendors were considered.

To determine the costs needed for the financing program, initial literature review and data analysis was performed based on the Energy Evolution modeled data. Further analysis will be completed as the pilot program gathers data and consultations with prospective participants take place.

All building retrofit measures that are deemed to not have a payback within the life of the asset are assumed to require subsidization. Incentives through a future Community Improvement Plan may be provided based on buildings reaching thresholds of energy performance as defined in the Retrofit Roadmaps or may be offered for specific measures.

Table 1 Program Budget

Revenues	**Value ($)**
FCM Grants requested	$175,000
City Capital budget	$122,900
City Existing Staff Time	$53,393
Total Revenues	**$351,293**
Expenses	
Wages + related costs	$53,393
Consulting and Service Fees	$297,900
Total Expenses	**$351,293**
Partners In Kind	**$30,000**

3.6.1 Program Funding

The Federation of Canadian Municipalities will be approached to expand the reach of this benchmarking and thermal audit program. On occasion, Natural Resources Canada also provides funding for various commercial retrofit programs and staff continue to

explore these opportunities. Utility conservation programs through Enbridge may have some similarities and, once the concept is proven, they may be willing to shift some of their funding towards this program.

To capitalize a revolving fund for a future financing program, loans from the Canada Infrastructure Bank and/or the Federation of Canadian Municipalities may be explored. City Sustainable Bond issuances may also be possible to develop a capital pool. If flow through capital pool cannot be secured, the financing program may not be developed.

The Community Improvement Plan is expected to be primarily self-funded based on future cashflows from increased tax revenues. Ideally, grant funds are secured to supplement this. Depending on the analysis, the Community Improvement Plan may not be implemented if grant funds are not secured to expand the tax revenues.

The committed City funds and partner funds are sufficient to offer the other aspects of the program.

3.7 City Roles and Responsibilities for Program Delivery

The program will be delivered by third party service organizations predominantly with City staff performing some key functions.

City staff will perform the following scope of work:

- Launching the Program and related online communications PIED, Climate Change and Resiliency; PIMR)
- Capitalizing a financing program (PIED, Climate Change and Resiliency and Economic Development and Financial Services)
- Assessing the feasibility of a Community Improvement Plan and developing one if appropriate (PIED, Climate Change and Resiliency and Economic Development and Financial Services)
- On-going evaluation, impact measurement and verification (PIED Climate Change and Resiliency).

Service delivery organizations' scope of work are being finalized and are expected to involve:

- Recruiting and supporting participants to benchmarking energy performance (BOMA, CaGBC, EnviroCentre, Hydro Ottawa, OCAF);
- Disclosing the energy and emissions data and delivering energy scorecards (CaGBC);
- Providing thermal scans and audits of buildings (QEA Tech);
- Publicizing workshops and training activities (BOMA, CaGBC, Envirocentre, OCAF, Hydro Ottawa);

- Providing training and certifications to contractors and trades (Ottawa Construction Association)

The following organizations will contribute to the program delivery in a collaborative way:

- Hydro Ottawa – for support from roving energy managers and associated demand management programs;
- AEEE – for technology expertise
- HRAI - for ventilation technology-specific expertise and supporting contractor training modules
- Treasury Board – for sharing expertise on shadow carbon pricing, embodied carbon, and sustainable procurement policies
- Ottawa Board of Trade - for recruitment of network participants, consultation support, and capacity building
- OCOBIA - for recruitment of network participants, capacity building, and consultation support

3.8 Potential Applications of the Program Results

This program is designed to determine the utility of thermal scans in building benchmarking and in driving retrofit uptake, particularly of building envelope improvements.

The Better Buildings Ottawa Benchmarking and Auditing Program will determine the impact that public disclosure of energy and emissions data has on retrofit rates and tenant attraction. It will also help to determine how to best support the commercial building owners through their emissions reduction efforts. The experience will be useful in identifying how to best expand the program into other building sectors, such as apartments and retail outlets.
It is also designed to assess the opportunity for, with empirical data and a cohort of investment-ready buildings, the creation of a financing program for energy and emissions performance in commercial buildings.

Long term, low interest financing is one tool that could enable building envelope improvements, particularly those with long payback periods. Such improvements then make all other mechanical improvements in the building more cost effective. By working with the program participants as a first cohort of potential borrowers, this program will help to determine the attractiveness and likely uptake of a municipal financing program and other future programs for energy reduction measures.

This program will also help to determine if the energy improvements targeted have a measurable impact on property values in Ottawa. This has been researched elsewhere and has been shown to have a positive impact in the range of 2 to 26% in office

buildings in particular[6], but the impact can also be affected by other local real estate pressures.

Finally, if tax increase cash flows justify and/or grant funding can be secured, a Community Improvement Plan incentive program may be developed to support deeper measures.

4. Next Steps

Tasks associated with launching the Program are described below. If additional funding is not secured, the program implementation may be affected.

Q3-4 2021: Final program design and approval

- Finalize roles, responsibilities, and delivery agreements
- Develop a website, marketing materials and intake process for participants
- Launch the program and recruit participants
- Hire staff as required to deliver on the program components.

6 https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/Appraisals_LenderGuide_FINAL.pdf

Appendix A: Feasibility Study to Justify Pilot Program

To develop this pilot program, staff completed an analysis of:

- Retrofit measures required in commercial buildings
- Type and age of commercial buildings
- Location of office buildings
- Financial feasibility of office retrofit measures
- Potential energy, water, and GHG emission reductions
- Co-benefit opportunities

1.1 Retrofit Measures Required in Commercial Buildings

Table 2 provides an overview of the integrated emissions modeling done through Energy Evolution and shows how commercial buildings (all those in Part 3 of the Ontario Building Code) must be transformed over the next 30 years to achieve the necessary GHG reductions. More details on the current energy use and emissions profile for buildings in Ottawa is available in Appendix B.

Table 2 ICI and MURB Retrofit actions from Energy Evolution Strategy

Action	2030	2040	2050
Envelope retrofits of small ICI buildings	27% (by area) - 60% thermal reduction - 30% electrical reductions (before fuel switching)	98%	
Envelope retrofits of large ICI buildings	27% (by area) - 50% energy savings	95%	
Heat Pumps – MURBs	44,322 installed - 72:28 air:ground	82,728 installed	
Heat Pumps – ICI	38% space heat load		73% heat load
Electric Hot Water			63% of load

1.2 Type and Age of Buildings

To assess the feasibility of this proposed program, staff used data available from the Energy and Water Reporting and Benchmarking (EWRB) program of the province which requires all buildings greater than 100,000 ft^2 report their energy and water use. To date, less than 50% of eligible buildings in Ottawa are reporting, so this program is designed to improve that uptake. The EWRB program releases data in aggregate form and not at the address level. In the United States, 69% of benchmarking programs make the data available at the address level. These programs show a high participation

rate, particularly where compliance is compulsory. They also show an energy reduction rate of 2% per year[7].

The EWRB data shows that office buildings in Ottawa emit the most GHGs cumulatively (see Figure 4). Although this data only represents buildings greater than 100,000ft^2, it is assumed that offices are also the dominant GHG emitters for buildings greater than 20,000ft^2. Benchmarking will help confirm this.

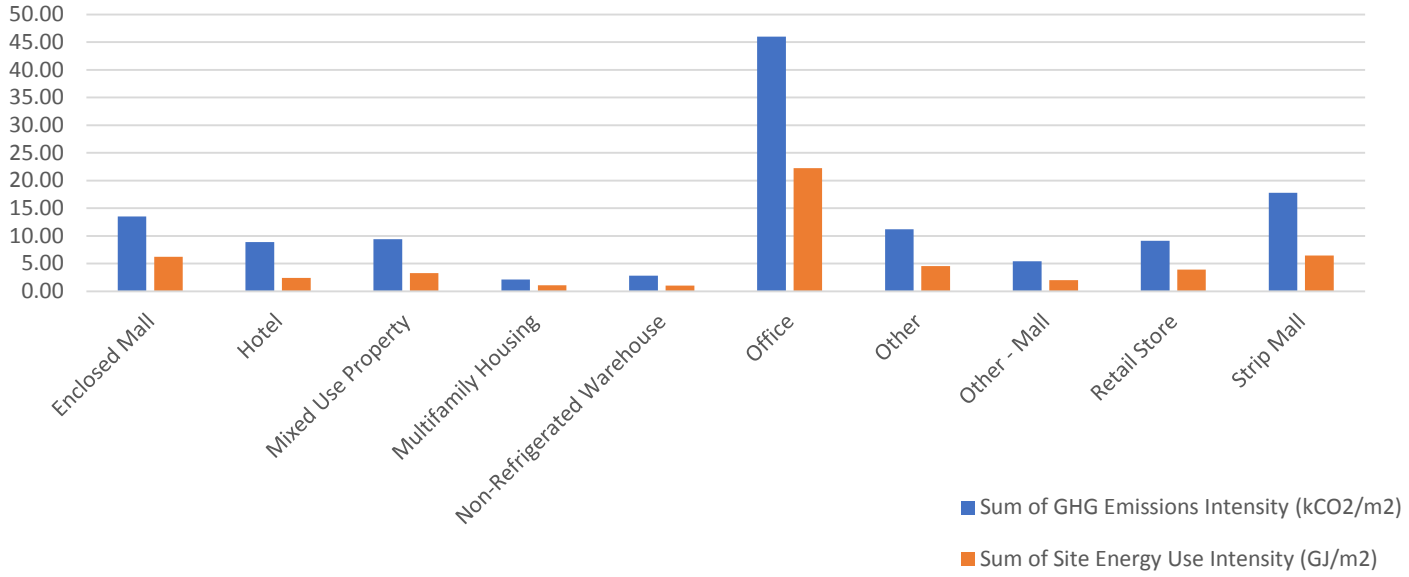

Figure 4 GHG emissions from commercial buildings in Ottawa >100,000ft^2

An analysis was done of energy saving potential by commercial building type. Generally, older buildings have higher potential for energy savings. To facilitate analysis, the commercial buildings were grouped by age of construction into vintages of similar energy profiles as follows:

- Vintage 1: 2005-2016
- Vintage 2: 1980-2004
- Vintage 3: 1961-1979
- Vintage 4: 1960 and older

The Figure 5 shows that office buildings make up 40% of all the commercial building space, which is the single largest sector by area. It also shows that the split of office buildings by vintage is relatively even, with slightly less of vintage 4, or pre-1960s buildings. As a result, this pilot program is focusing on office buildings as an initial building typology. An additional rationale for selecting office buildings is that many of

[7] https://www.imt.org/resources/comparison-of-commercial-building-benchmarking-policies/

them are currently empty and being renovated for a post-pandemic reality, so there exists a unique opportunity to install energy-saving equipment.

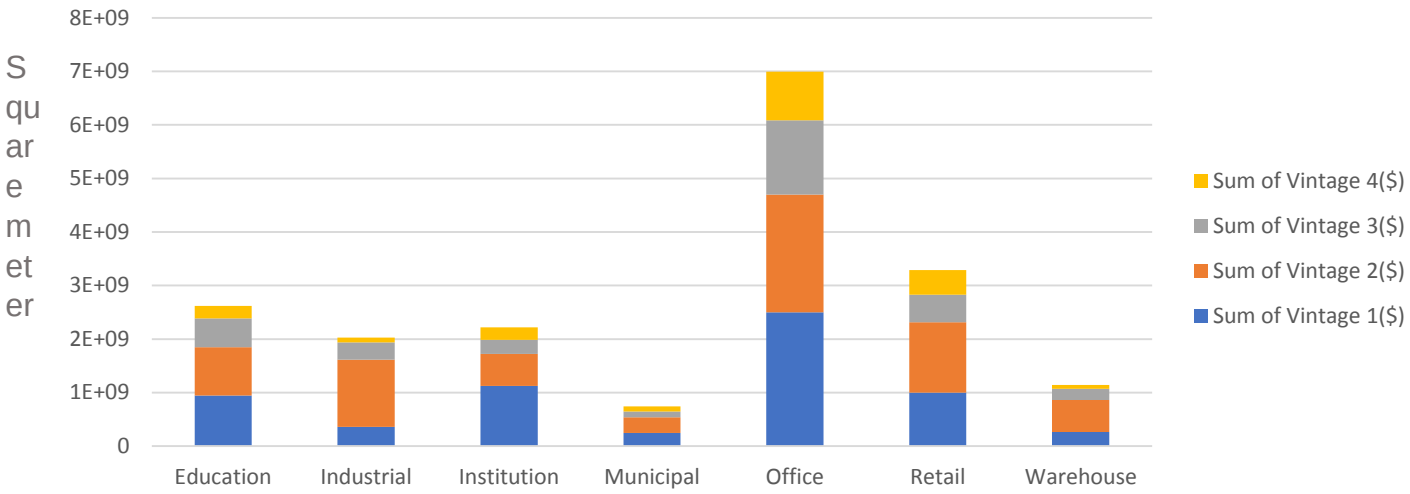

Figure 5 Area of commercial building types by vintage

1.3 Locations of Office Buildings

Next, the transportation zones with the highest density of offices were identified. The zones in Figure 6 and Table 3 are proposed to be the priority areas for initial program marketing and outreach efforts, however, the program will remain open to all eligible, privately-owned buildings in Ottawa if they choose to apply.

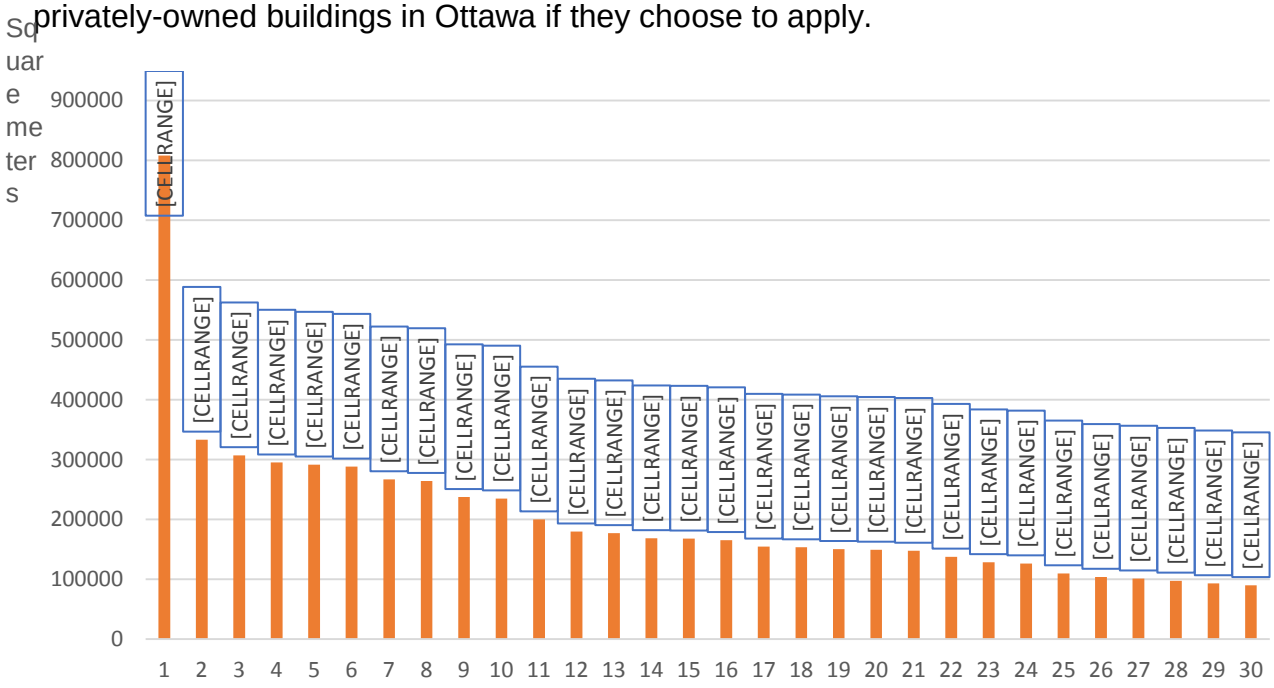

Figure 6 Office building area by traffic zone

Table 3 Priority Neighbourhoods for Program Outreach

Zone	Neighbourhood		Zone	Neighbourhood
230	Sandy Hill		131	Centretown
162	Centretown		210	Byward Market
182	Centretown		5360	Brookside - Briarbrook - Morgan's Grant
172	Centretown		220	Byward Market
141	Centretown		110	Centretown
151	Centretown		132	Centretown
5372	Brookside - Briarbrook - Morgan's Grant		700	Byward Market
163	Centretown		152	Centretown
2460	Island Park - Wellington Village		1670	Riverside Park
1222	Carson Grove- Carson Meadows		1080	Overbrook - McArthur
142	Centretown		521	Centretown
631	West Centretown		1041	Overbrook - McArthur
171	Centretown		4250	Greenbelt
201	Byward Market		501	Centretown
2852	Greenbelt		1660	Riverside Park

1.4 Financial Feasibility of Office Retrofit Measures

Energy Evolution included a financial analysis of actions that were projected to have financial impacts. This analysis looked at all commercial buildings of 20,000ft^2 or more as one category, which is how they are presented in Figure 10 to 10 below. Data that informed the analysis included:

- Aggregate utility consumption data
- Building age and size
- Future costs of energy based on published studies
- Carbon pricing as currently legislated by the federal government
- Future capital and operating costs for equipment based on market trends.

The financial analysis suggests that, in order to meet Ottawa's GHG reduction targets, a cumulative community-wide investment in commercial building retrofits (including multiunit residential buildings) from 2020 to 2050 will total $1.9 billion with a net return of $ 3 billion over the asset life.

This financial analysis assumes that:

- Building owners are borrowing 100% of funds at 4% interest rates for 20-year amortization periods on average
- Retrofit capital costs, operating costs, and maintenance costs are included in the long term payback calculations
- The carbon price increases to $50/TCO2 by 2022 and increases by inflation thereafter. (Note: if the carbon prices increases to $170/T by 2030 as proposed

by the federal government in December 2020, the financial attractiveness of all of these measures will be improved)
- These are high level estimates that are currently uncommitted and unfunded capital and operational needs

The following retrofit measures were assessed as part of the financial analysis:
- Building envelope improvements (including wall insulation, roof insulation, and windows)
- Ventilation and mechanical equipment
- Electrical retrofits

When looking at an average office of 75,000 ft^2 in each vintage, the financial modeling shows that the most expensive measure for each vintage is wall insulation followed by roof insulation (Figure 7). This assessment assumed the following retrofit measures:

- 50% space heating savings (as per the target set in the Energy Evolution Strategy)
- Installation of a heat pump and electric water heater and
- Addition of 100 kW solar photovoltaic system

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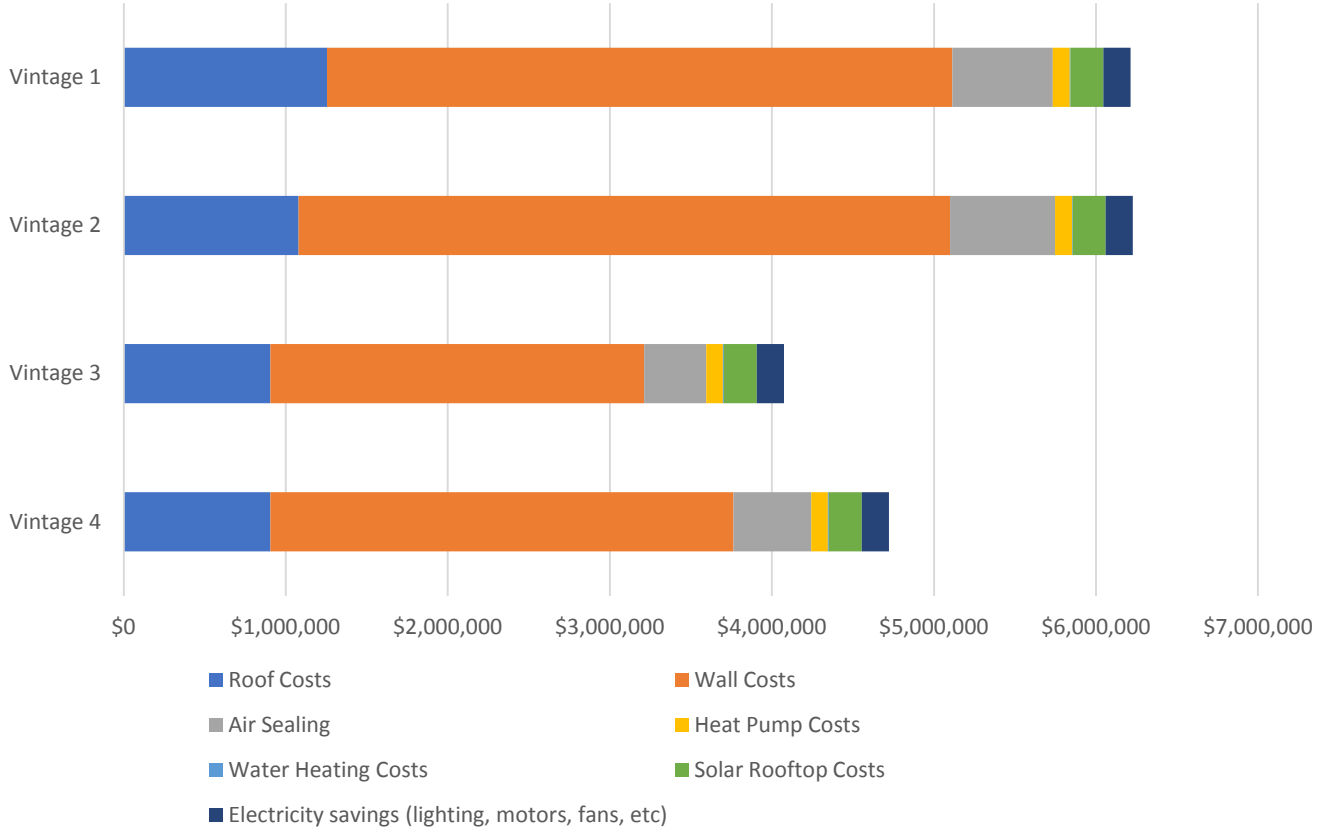

Figure 7 Retrofit costs per measure per vintage of office building, assuming an average size of 75,000ft^2

Based on Figure 7, the envelope costs (roof, walls, and air sealing) are clearly the most significant across all vintages. Looking at those measures on a cost per unit of energy saved, it becomes apparent that:

- Roof insulation costs are less cost effective in newer buildings
- Wall and roof insulation in older buildings has a lower cost per unit of energy saved
- Air sealing costs across all vintages has a relatively low cost per unit of energy saved
- Vintage 3 buildings (built between 1961-1979) are the most cost effective for all measures, which could be due to their relatively larger size than older buildings but still relatively inefficient compared to1980s or newer buildings.

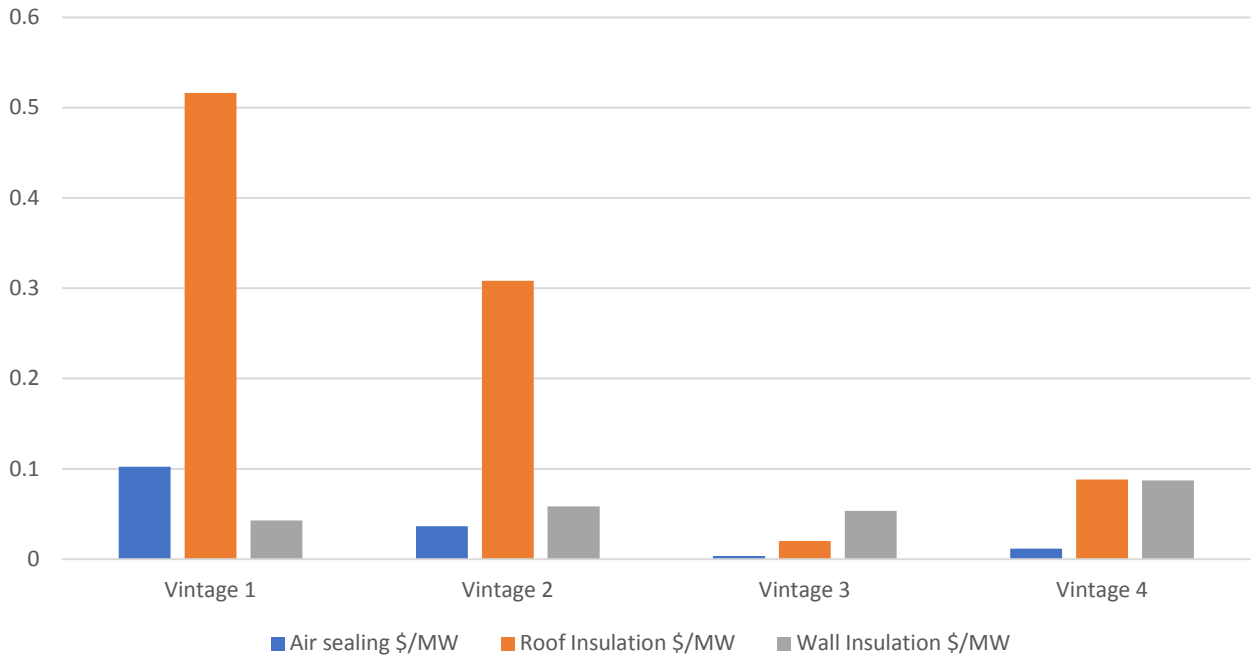

Figure 8 Relative costs of envelope efficiency measures per vintage

The sector-wide financial analysis of the Energy Evolution model showed that:

- Of the commercial building types, offices require the most investment to retrofit (Figure 9)
- Building retrofits (including envelope improvements, ventilation, and electrical savings) have positive returns on investment (Figure 10)
- Heat pumps have a negative return on investment (Figure 16)
- If the measures are bundled, the return on investment is positive (Figure 12). This suggests that a strategic focus for the program should be on driving down the cost of heat pumps through techniques such as bulk purchases, contractor training, and incentives.

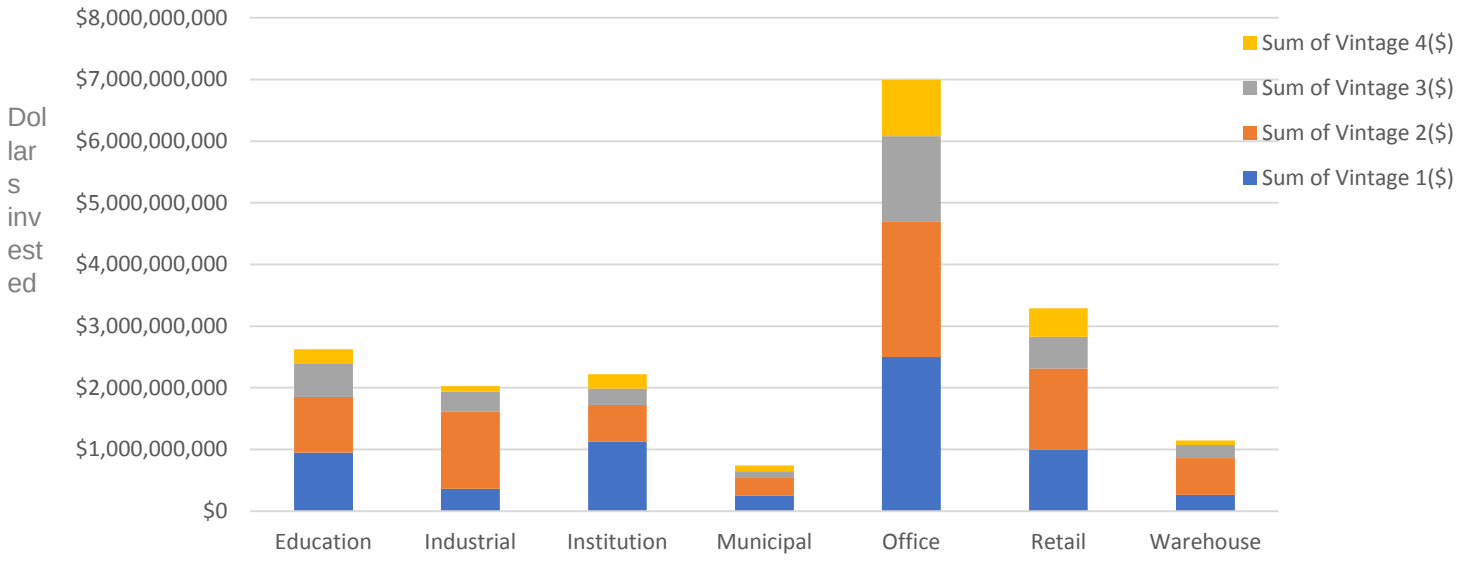

Figure 9 Estimated investments required for each commercial building type and vintage, from Energy Evolution financial model

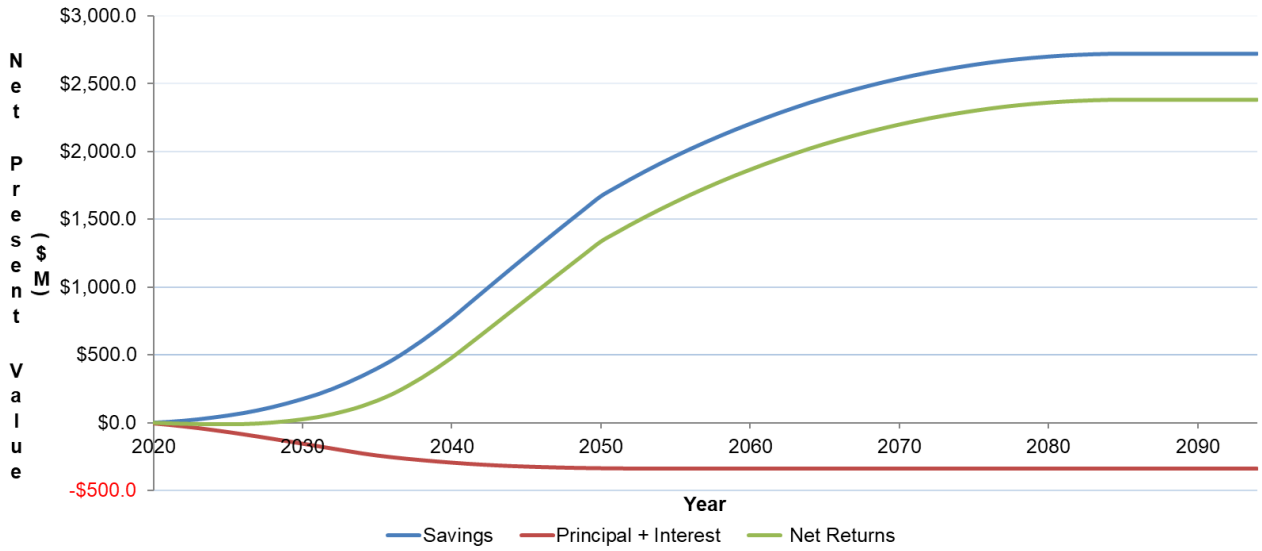

Figure 10 Financial profile for building envelope, ventilation, and electrical retrofits of all commercial buildings > 20,000 ft^2

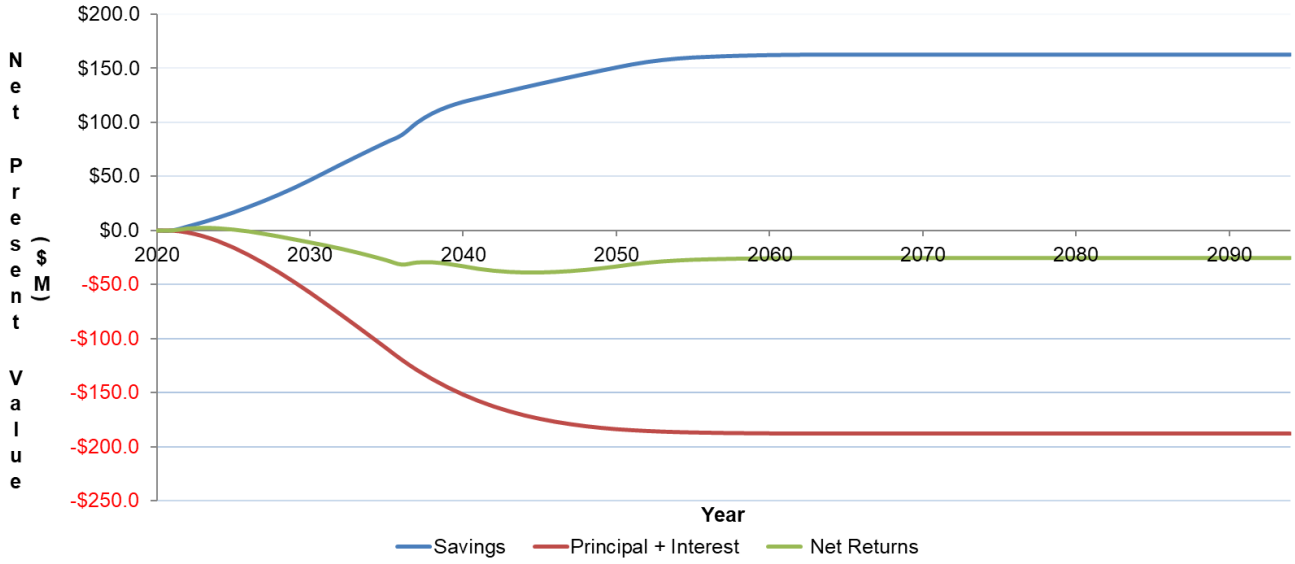

Figure 11 Financial profile for heat pumps in all commercial buildings >20,000ft^2.

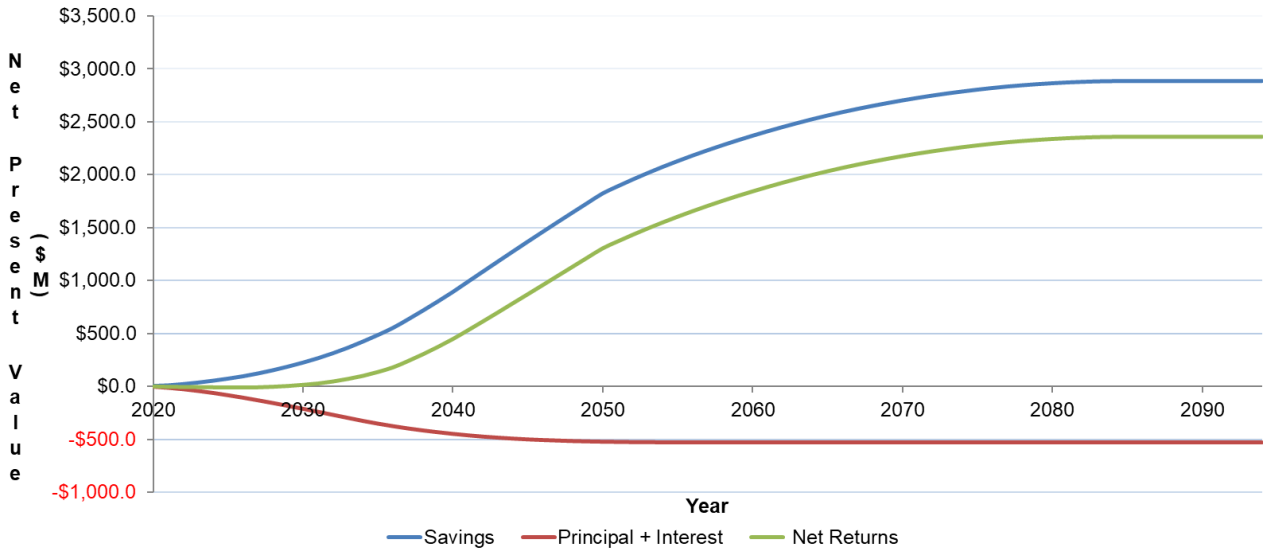

Figure 12 Financial profile for all commercial building retrofit actions bundled with heat pumps.

1.5 Projected GHG Emission Reductions

The emissions reduction profile for commercial buildings under the 100% Scenario as compared to the Business as Planned Scenario in the Energy Evolution model is depicted in Figure 13. The emissions reductions start modestly and grow to 550 ktCO2e per year by 2050.

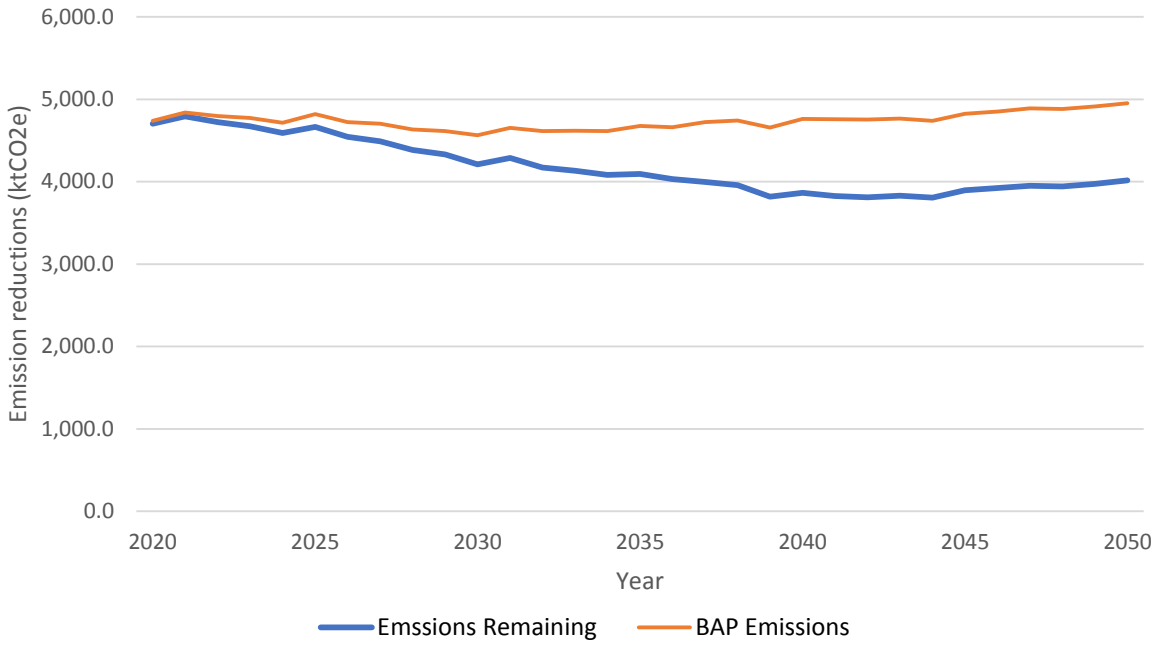

Figure 13 Emissions reduction profile for commercial buildings under the Energy Evolution 100% Scenario compared to the Business As Planned Scenario

Retrofits quantified though this program are expected to average $5.4 million per building based on the Energy Evolution modeling. Typically, buildings implement the measures over many years, so if 25% of the measures are implemented during the next three years in 75 participating buildings, this represents $101 million in investments.

Given the projected cost per kilotonne of CO_2 emissions in commercial buildings, this represents 79 $ktCO_2$ emissions reductions per year or 1580 $kTCO_2$ over a 20-year asset lifecycle. In energy terms, that represents 3,334 GJs of savings annually or 66,680 GJ over a 20-year asset lifecycle. It is also expected that 10% of participating buildings will add a 100kW solar array on the roof, representing 2700 GJs of additional solar energy per year, or 54,000 GJ over a 20-year asset lifecycle, which equates to 0.02 $ktCO_2$ over the same period.

1.6 Co-Benefit Opportunities

There are “collateral benefits” (called co-benefits) of emissions reductions from buildings. These can be grouped into economic development opportunities and social/health opportunities.

1.6.1 Economic Development Opportunities

Benefits that we can expect from this program to the regional economy can be summarized as follows:

- Enable buildings to be investment-ready
- Create green tech jobs

- Improve employee productivity and retention as well as increasing building asset value
- Build on high-tech expertise for smart tech solutions
- Attract new types of business to the region
- Help businesses recover from the pandemic
- Transparency to tenants and improve energy literacy
- Avoid future costs from damage from extreme weather
- Avoid future cost associated with rising carbon costs

- *Enable buildings to be investment-ready*

Building energy upgrades require significant private investments. This project will prepare buildings to be investment-ready. Retrofits quantified though this program are expected to average $5.4 million per building. Approximately 150 buildings will receive thermal audits, making them investment-ready. Typically, buildings implement the measures over many years, so if 25% of the measures are implemented in 150 buildings during the program term, this represents $202 million and another $608 million after the term. This is a large enough investment opportunity to secure favourable financing terms for all from lenders such as the Canada Infrastructure Bank. The program will enable collaboration between building owners and accelerate innovation through sharing of studies, templates, standards, legal opinions, etc.

- *Create green tech jobs*

Building retrofits provide the most significant job creation opportunity identified in the Energy Evolution Strategy. According to the Task Force for a Resilient Recovery, 16 to 30 jobs are created for every $1 million invested in efficiency retrofits, so this program will result in 544 to 1,021 jobs during the term and up to another 3,064 as retrofits are completed[8]. These new jobs will be predominantly skilled engineering and trades positions.

- *Improve employee productivity and retention as well as increase building asset value*

Improving office space by making it more energy efficient will improve thermal regulation, ventilation, occupant comfort, productivity, and ultimately asset value. Lease values are found to increase 10% and building values by 25% when properties are more efficient, as commercial spaces are valued proportional to the value of their

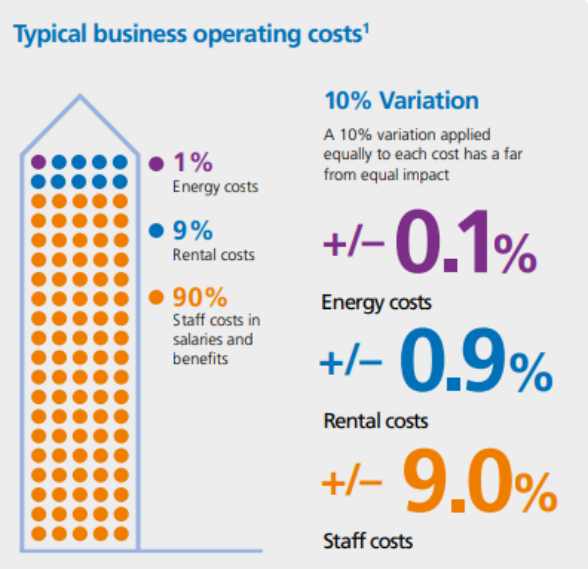

Figure 14 Typical business operating costs

[8] https://data.fcm.ca/documents/COVID-19/fcm-building-bac
together.pdf?_cldee=Y2FwaXRhbHdhcmRAb3R0YXdhLmNh&r
bee42a6e8847ea1180fa005056bc2eb3-541ec7d814374878ac
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leases[9]. For office building tenants, staff costs, including salaries and benefits, typically account for about 90% of business operating costs. Replacing an employee typically costs 1.5 to 2 times the lost employee's salary. Therefore, what may appear a modest improvement in employee health or productivity can have a huge financial implication for employers – one that is many times larger than any other financial savings associated with an efficiently designed and operated building. [10]

- *Build on high-tech expertise for smart tech solutions*

The region has a foundation of expertise in high tech solutions. Many of the green building and low carbon solutions for buildings will build on that foundation, including building automation systems and sensors (SMART buildings), SMART grid technologies, renewable energy and storage technologies, and electric transportation options. This program will enhance business in the green tech sector and skilled contractor sector in Ottawa by stimulating demand and helping building owners become investment-ready for deep energy retrofits. Given that the federal government is the single biggest occupier of commercial building space in Ottawa, by aligning the targets with those of the federal government's Greening Government Strategy, this program will provide consistency in the market through common procurement policies and standards, thereby enabling environmentally friendly service providers to expand in Ottawa.

- *Attract new types of business to the region*

It is expected that new business sectors will be simulated through this program including engineers and architects with net zero expertise, building automation and controls experts, high quality windows, efficient lighting providers, heat pump installers, district energy suppliers, renewable energy and storage experts, insulation manufacturers and installers, air sealing contractors, green financiers, among others. As market demand increases, there may prove to be an opportunity to attract a manufacturer of wood fiber insulation, high grade windows, low carbon concrete, and/or heat pumps to Ottawa to service the region.

- *Help businesses recover from pandemic*

By supporting and leveraging the post-pandemic renovations, the building space in Ottawa can be made more energy efficient, productive as well as healthy for occupants, and ultimately more attractive to tenants. This will improve the asset value for property owners.

- *Transparency to tenants and increasing energy literacy*

[9] IMT *Energy Benchmarking and Transparency Benefits* https://www.imt.org/wp-content/uploads/2018/02/IMTBenefitsofBenchmarking_Online_June2015.pdf

[10] https://www.worldgbc.org/sites/default/files/compressed_WorldGBC_Health_Wellbeing__Productivity_Full_Report_Dbl_Med_Res_Feb_2015.pdf

Through benchmarking at the address level and publishing street view thermal scans, tenants and prospective buyers will have more awareness of the energy consumption of a building and will be able to protect themselves from risk as well as becoming part of the solution through approaches such as green leases. Real estate agents will become increasingly aware of the value of efficient buildings and will further support the valuation of efficient buildings.

- *Avoid future costs from damage from extreme weather*

Every dollar invested in climate adaptation saves $6 in future costs — at a time when annual property damage costs nationally from extreme weather have already risen from $405 million (1983–2008 average) to $1.8 billion in 2018. (National Institute of Building Sciences, Insurance Bureau of Canada).[11]

1.6.2 Social and Health Opportunities

Reducing fossil fuel combustion will result in reduced air pollutants in addition to carbon emissions. Conserving energy in buildings also results in lower electricity consumption peaks. Shaving peaks is important in reducing the overall land use impact of electricity generation, because fewer backup power plants are required to meet peaks.

The process of realizing energy conservation and emissions reductions in buildings can improve quality of life for diverse communities within Ottawa. Indicators include improvements in health, economic prosperity, and socially equity. There can also be co-harms that arise from certain actions and identifying those are also helpful to inform appropriate policy and program design. The analysis and assessment of co-benefits and co-harms from the actions related to buildings is summarized in *Table 4*.

Table 4 Summary of Co-benefits Associated with Building Actions in the 100% Scenario

Co-benefits	Impact overview	Buildings	Energy
1. Health			
1.1 Air quality	Improvement in air quality.		Improved: reduced natural gas combustion.
1.2 Physical activity	Increased active transportation mode share.		
1.3 Noise	Decreased exposure to engine noise.	Improved: insulation in buildings reduces	

[11] https://data.fcm.ca/documents/COVID-19/fcm-building-back-better-together.pdf?_cldee=Y2FwaXRhbHdhcmRAb3R0YXdhLmNh&recipientid=contact-bee42a6e8847ea1180fa005056bc2eb3-541ec7d814374878ac8bdd2cf783f668&esid=e279270e-da3b-eb11-80d8-005056bc7996

		exterior noise.	
1.4 Accessibility (distance)	Destinations are more accessible.		
1.5 Buildings	Building quality is improved to make buildings more comfortable and efficient, including during extreme weather events.	Improved: indoor environments from enhanced building performance requirements and retrofits.	
2. Social equity			
2.1 Poverty	Housing costs increase, but the cost of transportation decreases.	Improved: social housing as retrofits and operating costs of housing decline.	Mixed: opportunities to participate in the renewable energy economy may be limited for those in poverty; district energy can provide secure and cost-effective heating and cooling.
2.2 Elderly	Accessibility for the elderly improves. The built environment is healthier.	Improved: buildings are healthier and more resilient.	Improved: air conditioning from heat pumps is widespread, reducing the impacts of heat waves on the elderly.
2.3 Children	Accessibility for children increases. The built environment is healthier.	Improved: buildings offer healthier and more resilient environments	
2.4 Intergenerational equity and resilience	The burden on future generations is decreased. Stranded costs are avoided by acting quickly where possible.	Improved: damage from climate change is reduced.	Improved: damage from climate change is reduced. Stranded costs are avoided.
2.5 Social capital	People interact more as a result of mixed-use development and increased walking and cycling.		

2.6 Environmental capital	There are more opportunities for green space in Ottawa. There is reduced pressure on green space outside of Ottawa.		Improved: energy generation in the city boundaries decreases the need for new generation capacity in green spaces beyond the city.

Appendix B: Energy Use and GHG emissions by Fuel Type and Building Type

In 2016, 48.2% of GHG emissions in Ottawa came from buildings, with commercial and industrial buildings contributing 22%[12]. These emissions are primarily from natural gas consumption, as shown in Figure 15. By switching to electricity and reducing overall consumption, the model for 100% Scenario anticipates GHG emissions will be reduced by 99% in commercial buildings by 2050 due to the low GHG emission grid in Ontario and the increase of renewable natural gas in the gas pipeline (Figure 16).

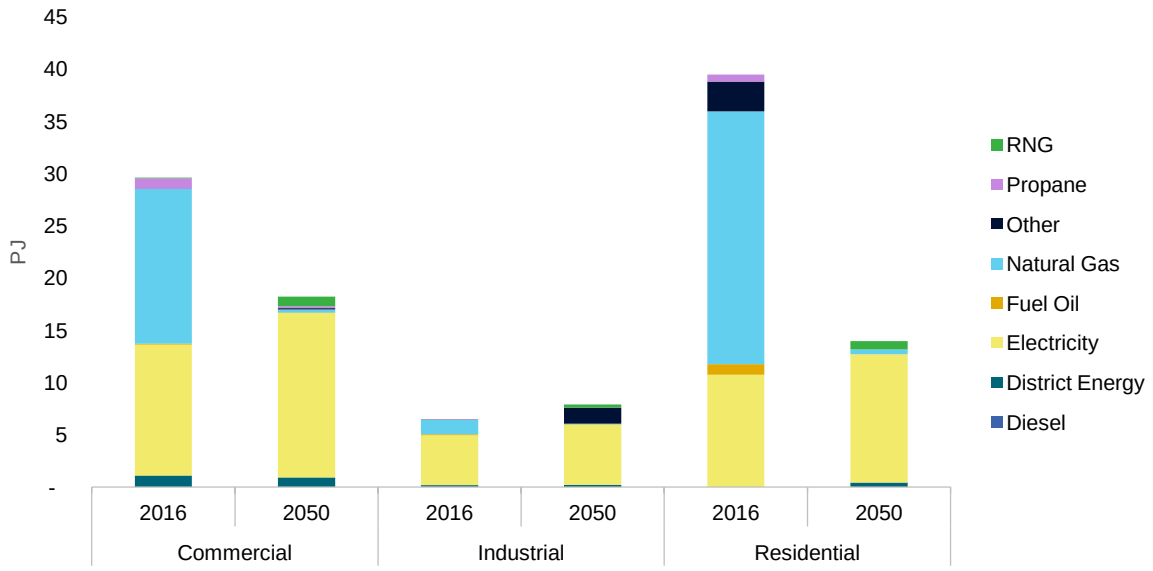

Figure 15 Energy use by fuel and building type, 2016 and 2050

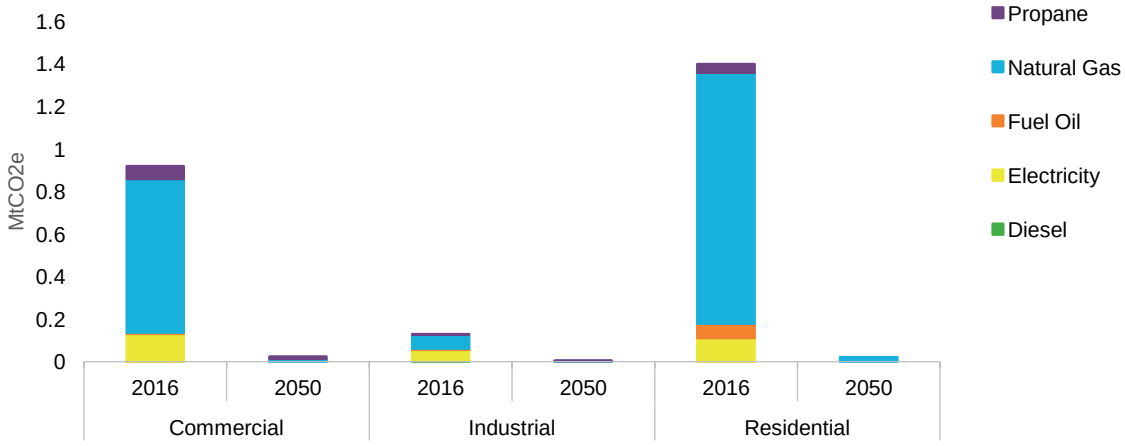

Figure 16: GHG emissions by building type and source, 2016 and 2050.

The use of energy and GHG emissions in commercial buildings is dominated by space heating in 2016. Other significant energy uses are plug loads and lights, as seen in Figure 17. For emissions, space heating and water heating make up the bulk of emissions, as shown in Figure 18.

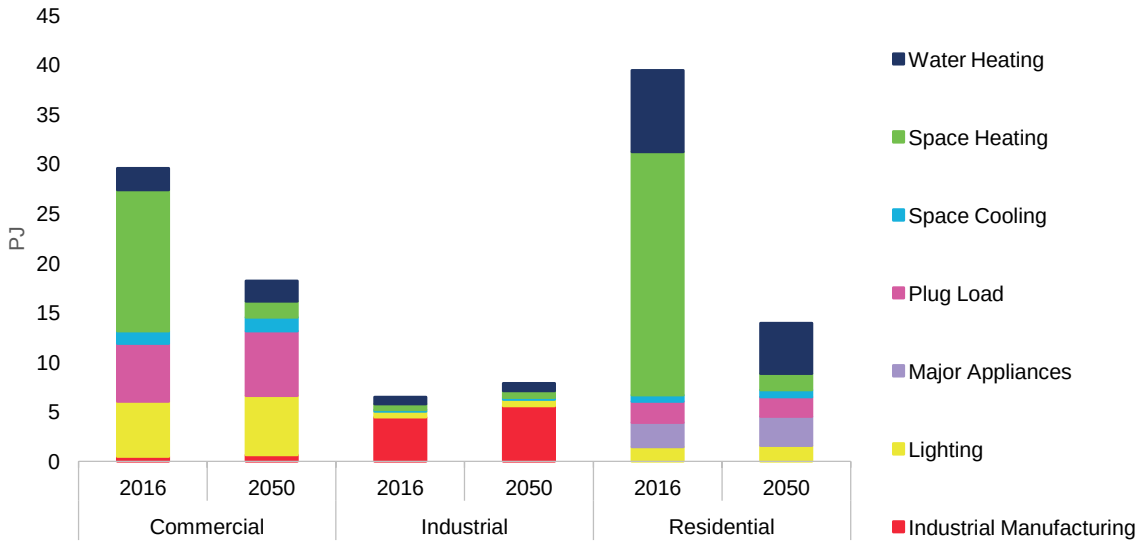

Figure 17 Energy use by building type and end use, 2016 and 2050.

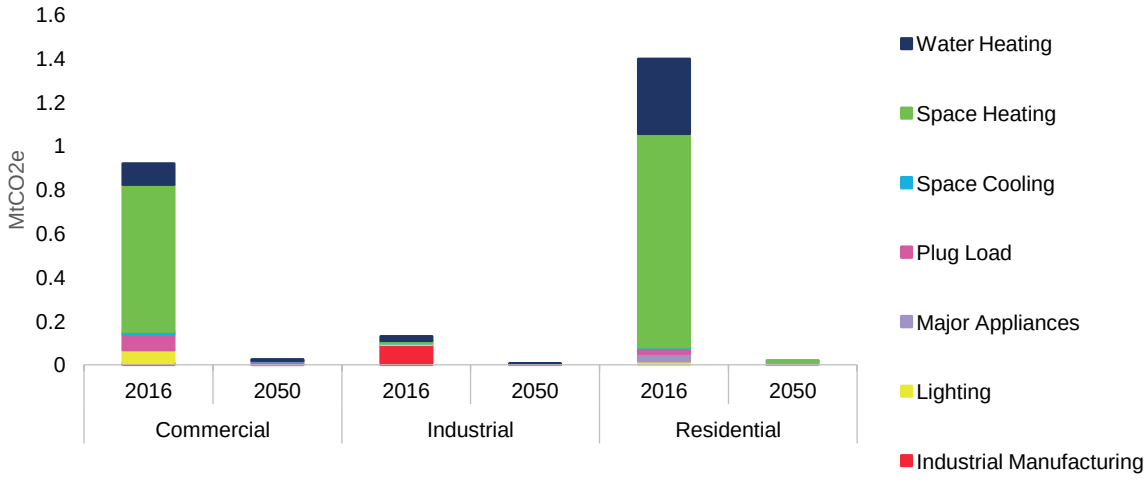

Figure 18 GHG emissions by building type and end use, 2016 and 2050.

This analysis demonstrates that effective emissions reduction programs for Ottawa should focus on reducing and electrifying space heating and water heating loads in the commercial sector.