Better Homes Loan Program: Feasibility Study

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1. Background

In 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.

1.1 Energy Evolution

Energy Evolution is one of eight priorities in the Climate Change Master Plan and sets the framework for what it will take for Ottawa to achieve these GHG emission reduction targets. It is a carbon reduction strategy 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, 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 explores the scope and scale of change required if Ottawa is 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.

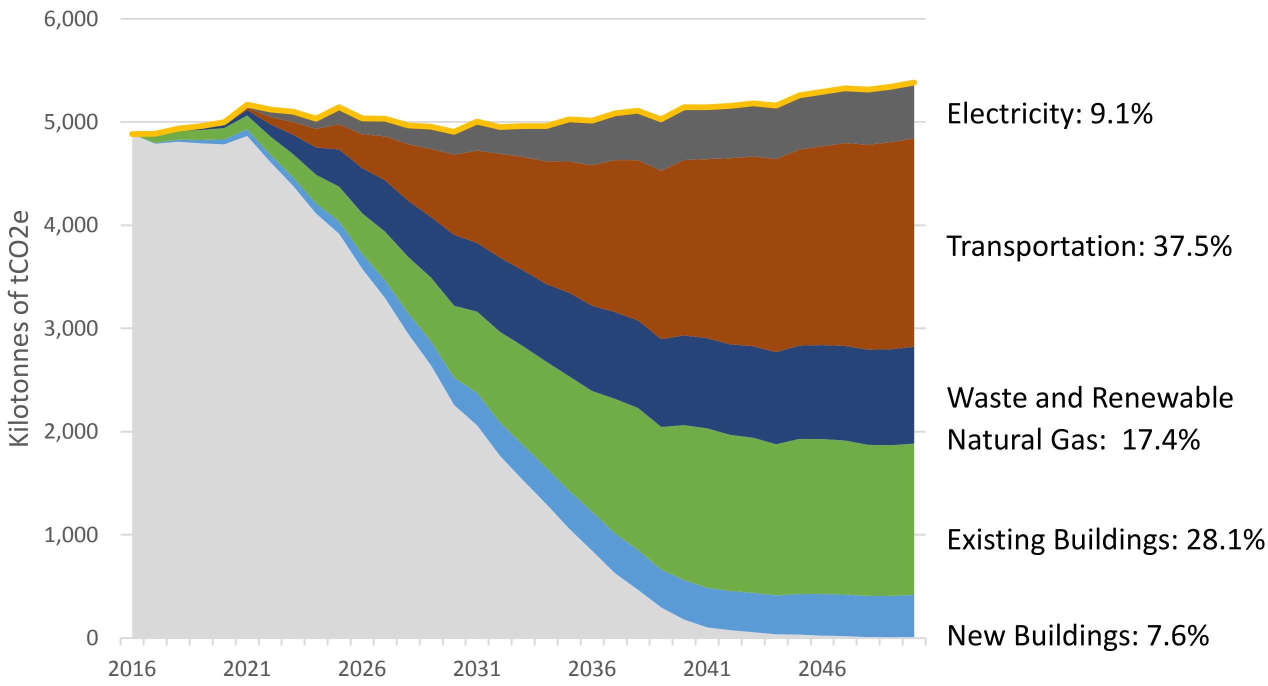


Figure 1 Projected community wide GHG emission reductions by sector to achieve the 100% scenario

In 2016, 48.2% of GHG emissions in Ottawa came from buildings, with residential buildings contributing 27.5%[1]. In the 100% Scenario, existing buildings are projected to provide 28% of the GHG reductions by 2050. Comparisons between the baseline, BAP, and 100% scenario and additional information about energy use and GHG emissions by fuel type, building type, and household can be found in Appendix A.

[1] In 2018, the residential share of emissions was 22%.

Integrated emissions modeling done through Energy Evolution shows that the residential building stock must be transformed the following ways over the next 30 years to achieve the necessary GHG reductions:

- Residential existing buildings must be retrofit for 70% heating savings and 30% electrical savings at a rate of 27% of buildings by 2030 and 98% by 2040 (or 327,000 single family units);
- 20% of residential roofs must have solar PV, totalling 320 MW by 2050;
- 560,350 residential heat pumps must be installed by 2040; and
- 15% of residential buildings must be served by zero carbon district energy by 2050.

The emissions reduction curve for part 9 residential 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 residential building envelope retrofits as well as heat pumps and rooftop solar photovoltaic.

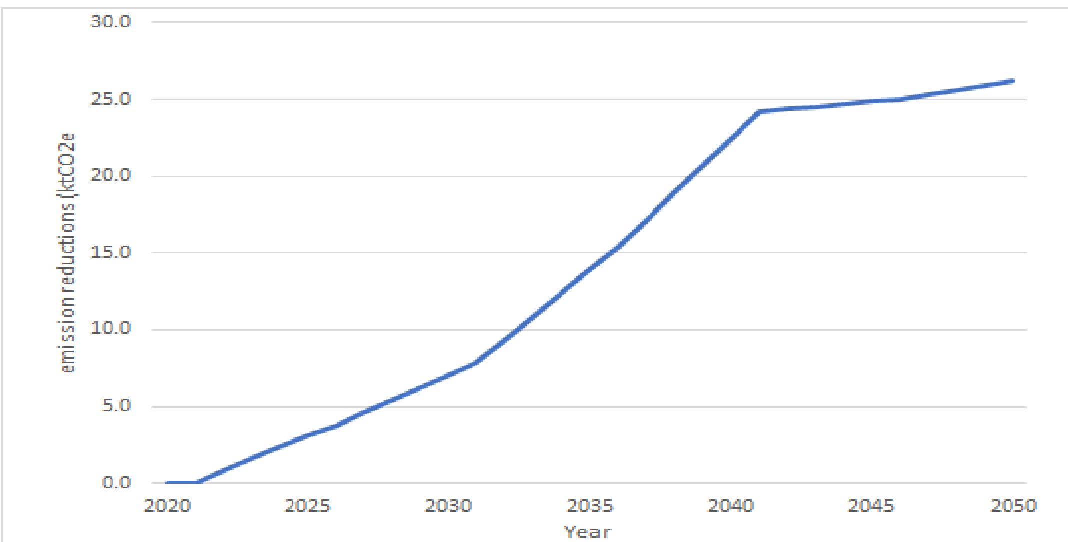


Figure 2 Emissions reduction profile for residential buildings

Financial analysis completed through Energy Evolution identifies that significant incremental investment is needed to achieve residential retrofit measures community-wide. Due to the scale of the investments, the ownership structure, and the other competing priorities for municipal investments, it is expected that the vast majority of the investments in retrofits will be private investments There is, however, a role for municipalities to play in catalyzing these investments and driving down the costs to residents while optimizing GHG reductions from the investments.

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

Residential Retrofit Accelerator Program to accelerate residential building retrofits through marketing, information and financial mechanisms. One of the components of this program uses a Local Improvement Charge mechanism to finance energy improvements. It is also supported by many other market transformation actions that, when implemented together, increase the likelihood of success of the financing program.

1.2 Local Improvement Charges

Municipalities are uniquely able to offer financing tied to a property using a Local Improvement Charge (LIC) 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.

Through an LIC 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.

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 homes and commercial buildings. A summary of many of these programs can be seen in Table 1[2].

[2] https://www.cleanairpartnership.org/wp-content/uploads/2020/05/FINAL-LIC-TOOLKIT-Accelerating-Home-Energy-Efficiency-Retrofits-Through-LIC-Programs-2020-1.pdf

Table 1 Comparison of Municipal LIC Retrofit Programs

	Toronto HELP	Clean Energy Financing, Nova Scotia	Town of Berwick, Nova Scotia	My Energy Improvement Plan, Nova Scotia	Halifax Solar City Program, Nova Scotia	Quebec [Inactive]	Alberta [proposed]	US HERO****
Financing								
Min financing							$3K	$2.5K
Max financing (% home value or $)	10% up to $75K	$10K-$20K	15%	$10K	75%	$10K-$20K	$50K	≤ 15-20%
Interest rate	3.7-4.3%	4-4.18%	4%	3.7-3.95%	4.75%	1%	TBD	2.75-8.35%
Term (years)	5-20	10	10	10	10	≤20	TBD	5-30
Admin/application fees	2% +	$550	5%	$199		$72.46	max 5%	varies
Early payoff option	✓	✓	✓	✓	✓	✓	✓	✓
Mortgage lender approval	✓	✗	✗	✓	✗	✗	TBD	varies
Home energy audit	✓	✓	✗	✓	N/A	✓	TBD	✗
Other credit rating info	✓	✓	✗	✗	✗	✗		✓
Performance or cost-effectiveness measures	✗	✓	✓	✓		✓	✗	varies
Contractor payor	homeowner	PDA	town	PDA		homeowner	PDA	PDA

Pre-qualified contractors	✗	✗	✓	✗	✗	✗	✓	✓
List of approved products/measures	✗	✗	✓	✗	✓	✗	✓	✓
Solar energy systems	✓	✓	✓	✓	✓	✗	✓	✓
EV infrastructure	✓				✗			
Administrator type	Municipality	Non-profit	Municipality / Private company	Non-profit	Municipality	Non-profit	Public agency	Private company
Municipalities served	1	4	1	2	1	3	1	many
Budget surpluses for financing	✓	✓	✓			✓	TBD	✗
Other financing sources	Green bonds	loans				grant	TBD	3rd party
Years of operation	2014+	2016+	2014+	2014+		2016-2017	-	2011+
Number of participants to date	202	44	12			24	-	125,000+
Average loans	20,000	7-10,000	~6000	8,000		13,000	-	$19K
Overall program budget	$2.7 million	40 projects/yr		10 projects/yr		$500,000	-	$3 billion
Average energy reduction	30%					29%	-	

Experience in other municipalities has shown that LIC programs drive energy efficiency improvements of approximately 30% in participating buildings per retrofit. Although this is not enough to meet the 64% energy reduction target set for residential buildings in Ottawa under the Energy Evolution Strategy, it is a good start that can be improved upon over time.

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

- Ownership term uncertainty and long payback period – Home ownership in Ottawa is approximately 7yr whereas retrofits often have a 10 to 20-year payback period, so longer than homeowners expect to stay in their home
- Limited understanding of how energy efficiency affects real estate value – Homeowners are not confident they will be able to recoup the investment at the time of sale
- Limited knowledge and motivation to retrofit – Proposed program provides expert advice and streamlines the retrofit process for a homeowner
- Access to long-term, fixed cost financing – Municipalities have access to fixed cost, long term financing that they can make available to homeowners through LICs. LIC programs 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
- Lock-in – By providing expert advice, the program can steer away from sunsetting technologies and fuels

Given that:

- Significant energy and efficiency improvements in residential buildings will be required to meet Ottawa's GHG emission reduction targets;
- Municipalities are uniquely positioned to offer LICs that are tied to the property;
- 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 like LICs have driven energy efficiency improvements and reduced barriers to energy retrofits for homeowners,

Staff assessed whether an LIC program is feasible for Ottawa.

2. Feasibility Study

To assess the feasibility of a new LIC program in Ottawa, staff completed an analysis of:

- The financial feasibility of residential retrofits
- The financial feasibility of Ottawa delivering a new LIC program
- Type and location of buildings to retrofit
- Potential GHG emission reductions

- Co-benefits and co-harms

2.1 Financial Feasibility of Residential Retrofits

As part of the financial analysis completed through Energy Evolution, a Revolving Loan tool was developed to project the capital needs and annual returns of each action in the Energy Evolution model independently or combined. When evaluated as individual measures, 18 of the 26 capital-intensive actions in the 100% scenario result in net savings in present dollars, discounted at 4.5% over the period from 2020 to 2050.

Figure 3 illustrates the marginal abatement cost for each of the actions in terms of the cost or savings per tonne of GHG emissions reduced. Savings include all savings associated with the action, including reduced energy expenditures, operating expenses, and avoided carbon price costs. Note that while actions are presented individually in Figure 3, there are feedback effects between the actions which re more accurately accounted for in the full GHG model that created the scenarios. According to the model, all these actions are required to achieve the 100% reduction target.

This marginal abatement cost analysis indicates which actions will be driven by market forces to be achieves and which are most likely to need incentives to be realized. Another approach to realizing actions with reduced paybacks is through bundling, which can help offset those actions with a less attractive paybacks.

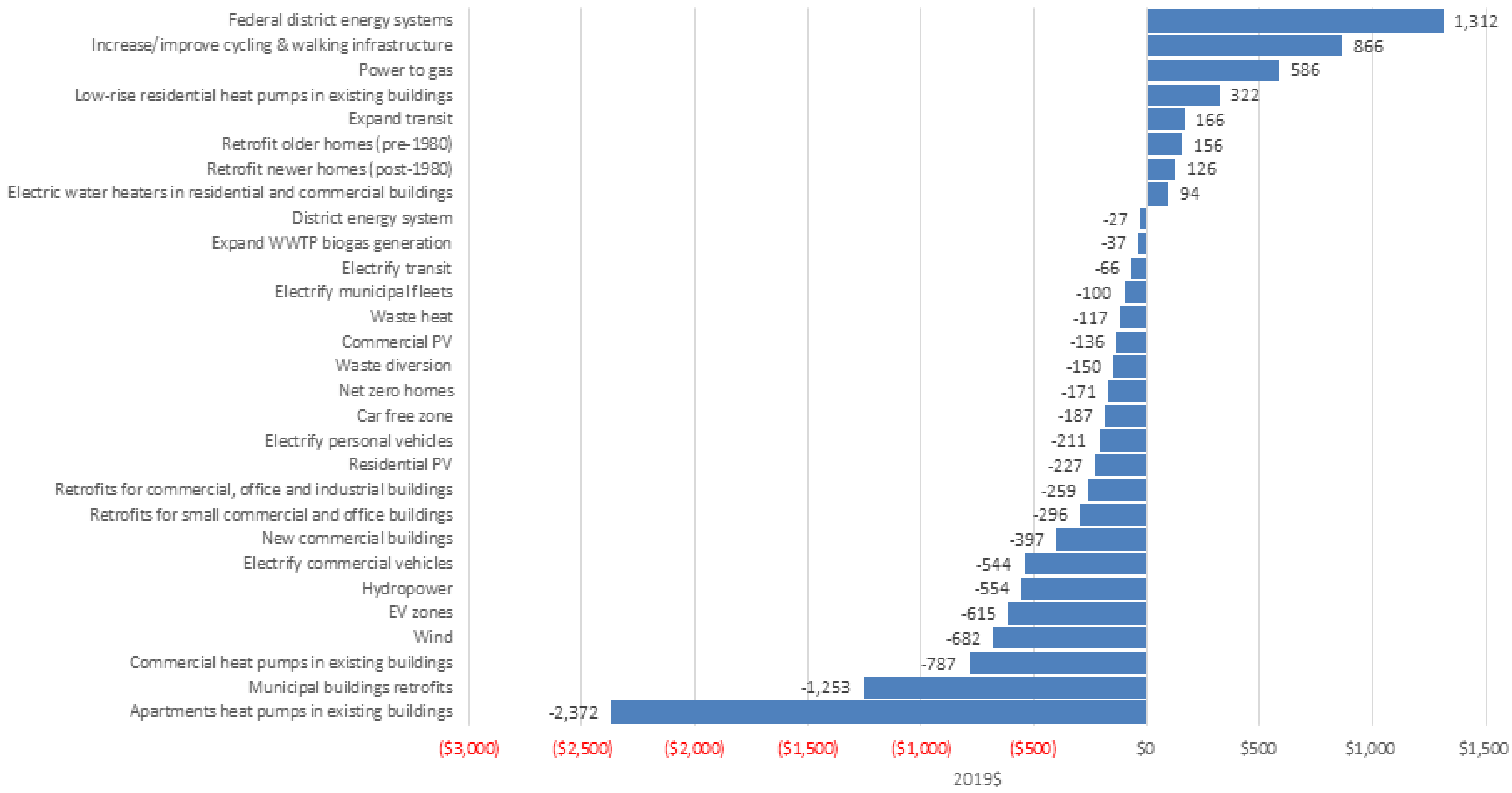


Figure 3 Marginal abatement costs of actions in the 100% Scenario

To assess the financial feasibility of financing residential retrofits, an assessment of each component that makes up a retrofit was first completed. This analysis assumes that homeowners are borrowing funds at 4% interest rates for 20-year amortization periods on average. Figures 4 and 5 show the investment and savings profiles for building envelope retrofits for part 9 residential buildings built pre and post 1980 respectively. Figure 6 shows the investment and savings profile for heat pumps in the part 9 residential building stock and Figure 7 the same for rooftop solar photovoltaic installations. The analysis presented in the figures below show that solar PV has the best return on investment followed by envelope retrofits while heat pumps lose money compared to BAP. This suggests that the actions should be bundled to result in a net profit for all, as shown in Figures 8. It also suggests that a focus needs to be on driving down the cost for the end user of heat pumps through techniques such as bulk purchases, contractor training, and incentives.

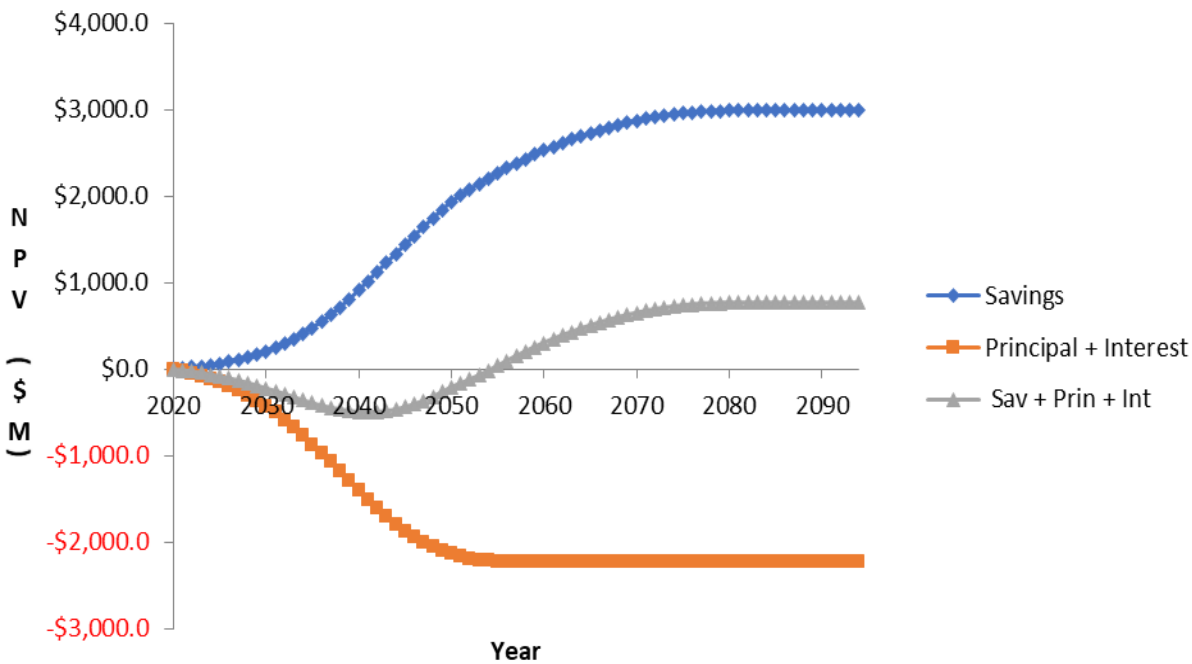


Figure 4 Return on investment profile for building envelope retrofits for part 9 residential buildings older than 1980.

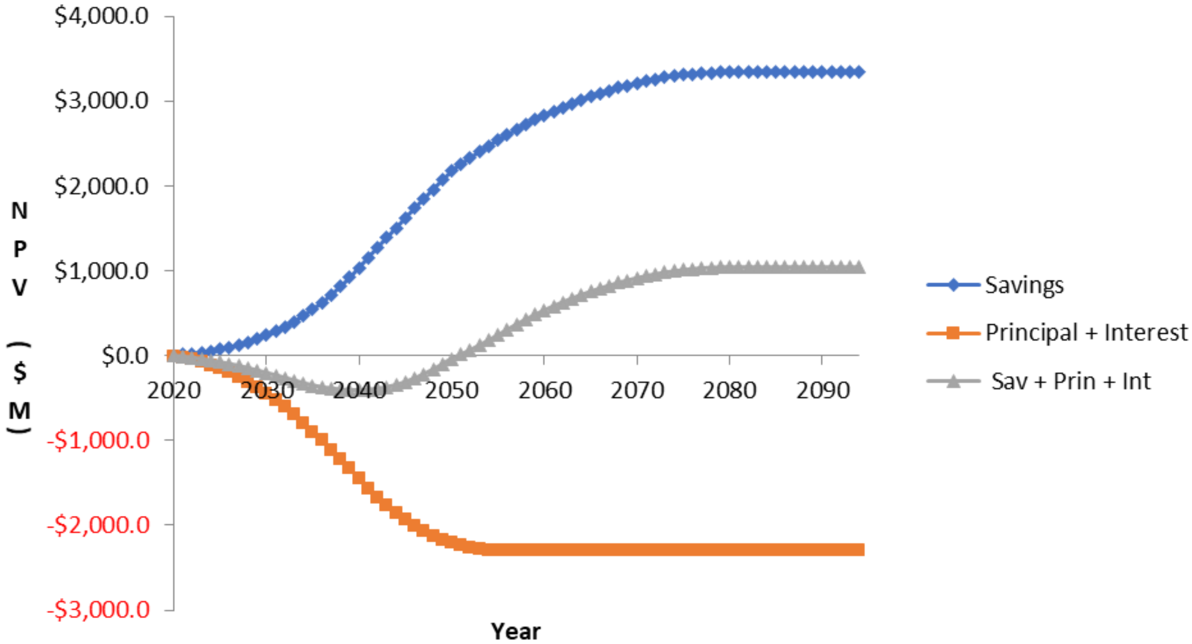


Figure 5 Investment profile for building envelope retrofits for part 9 residential buildings newer than 1980.

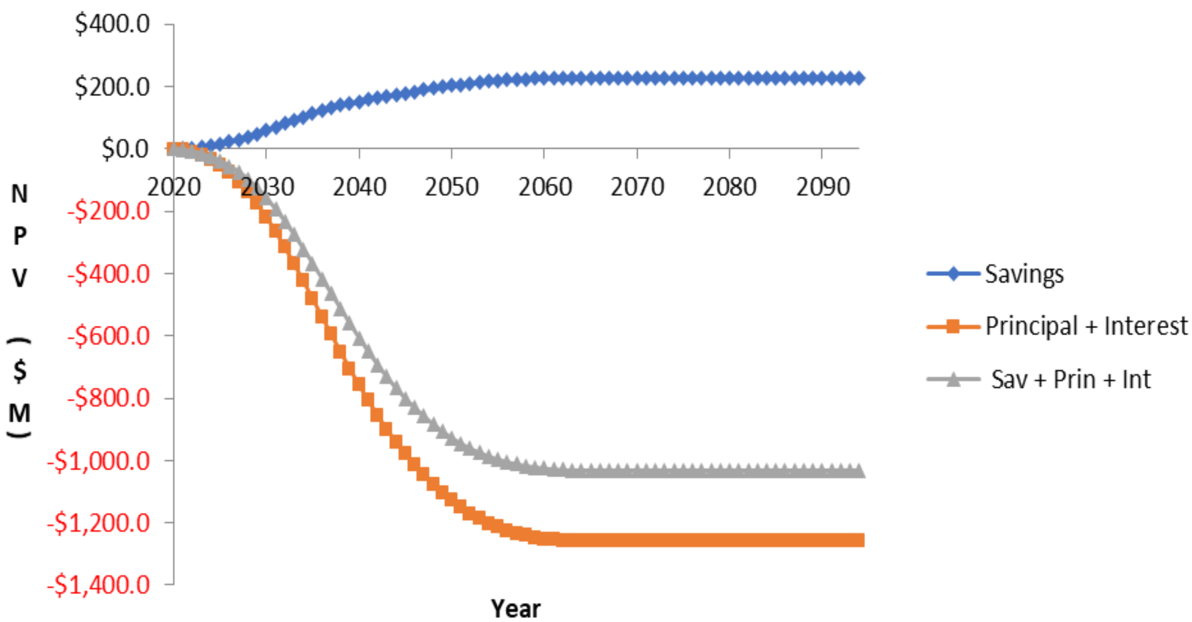


Figure 6 Return on investment profile for part 9 residential heat pumps.

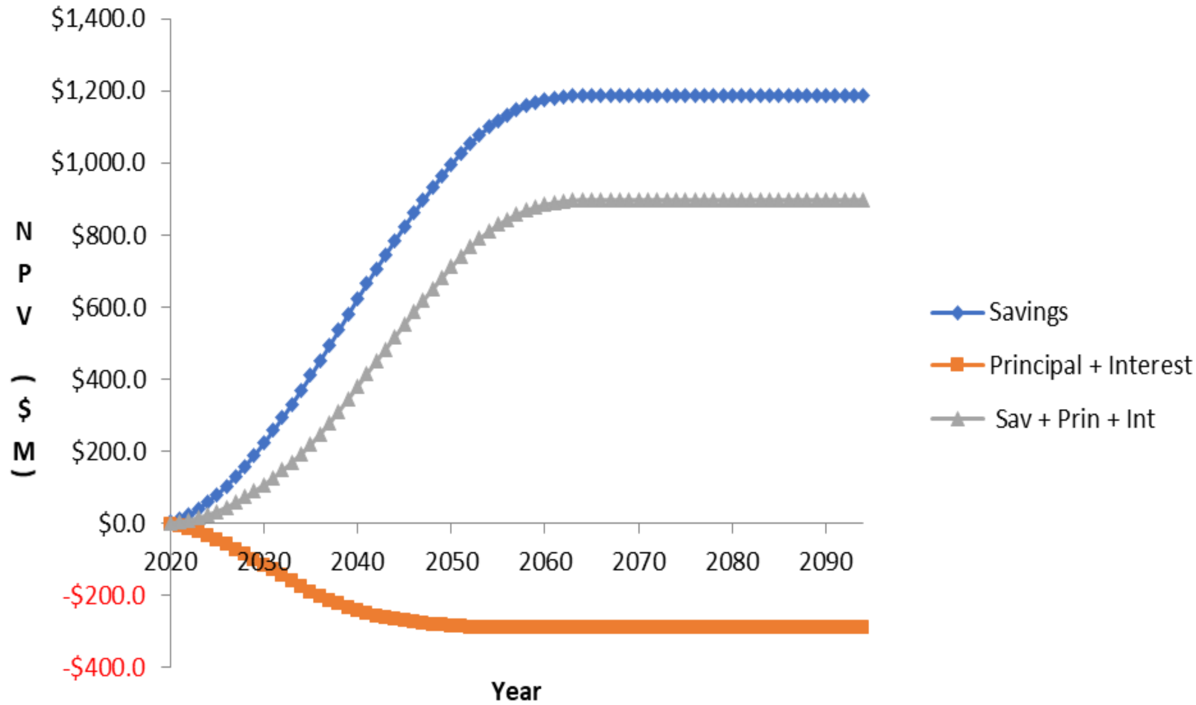


Figure 7 Return on investment profile for part 9 residential solar PV.

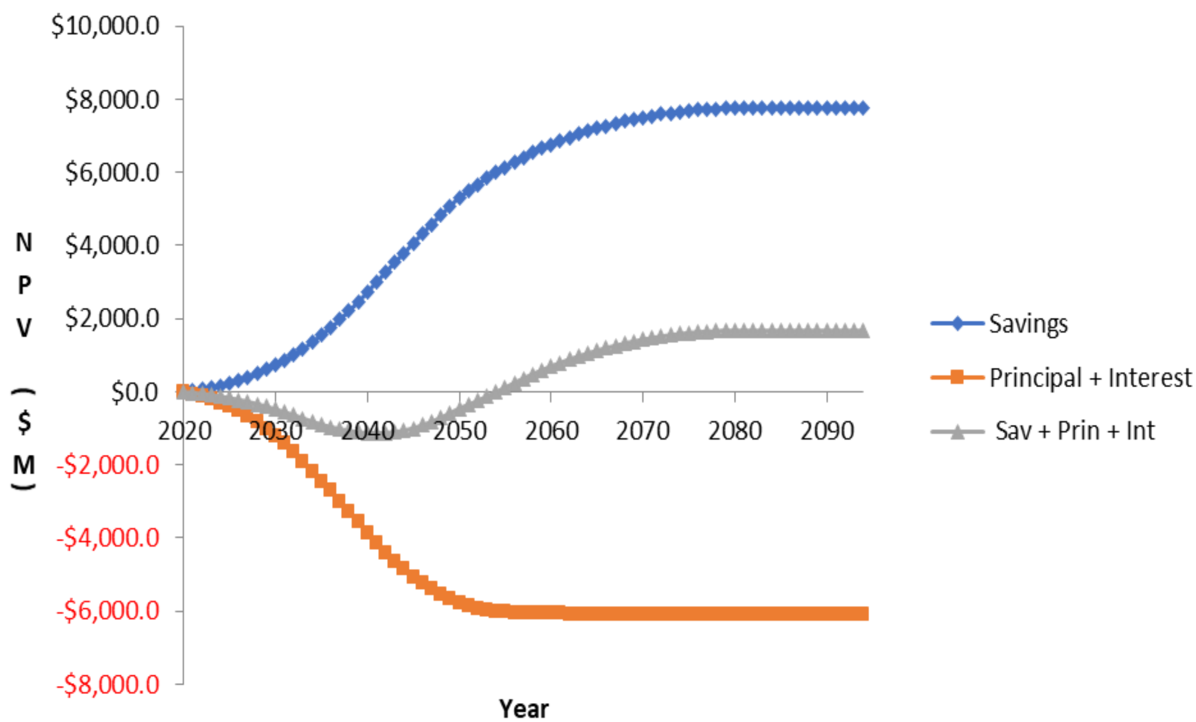


Figure 8 Savings profile for all residential retrofit actions bundled.

Given that the financial feasibility of retrofits improves when actions are bundled, a program should be designed to encourage the implementation of multiple actions at once. Given that this will have a higher capital cost and a long term payback, municipal financing through long term repayment terms tied to the property, made possible through the LIC mechanism, is seen as the most likely way to realizing these deep energy retrofits.

When looking at a single home in the target vintage (older than1960) for an assumed deep energy retrofit in 2020, the net savings to the homeowner more than pay back the retrofit costs. The assessment assumed the following retrofit measures: 70% space heating savings (as per the target set in the Energy Evolution Strategy); installation of an air source heat pump; and addition of 5kW solar photovoltaic system. The savings from the retrofit approximately pay off the loan capital. Newer homes that do not need to undergo wall insulation retrofits have a net positive cash position after the loan term. The cumulative carbon reductions for the deep energy retrofit by 2050 would be in the range of 80,000 to 115,000 kgCO2e. The value of the loan would be approximately 22% of the current value of these homes. If solar panels are not included in the first retrofit, that percentage drops to 6%.

2.2 Financial Feasibility of Ottawa Delivering a New LIC Program

To assess the feasibility of delivering a new LIC program in Ottawa, staff estimated program uptake, and completed an analysis of capital requirements, costs per household and cashflow projections. Initial program capital requirements and scale up projections for the first five years of the program are based on experiences in other municipalities, as shown in Table 2. Then, the scale up projections are based on the retrofit requirements deemed necessary from the Energy Evolution modeling, as shown in Table 3. When combined, the program participation objectives scale from 100 in 2021 to 20,000 by 2030, as depicted in Figure 9. The capital requirements for that level of participation is depicted in Figure 10.

Table 2 Program Uptake Trends in Canadian Municipalities

LIC Program	# Private Homes	Applications as of Mar, 2020	% of Total Homes	Years
Halifax Solar City	162,920	2,700	1.7%	7
Toronto HELP	820,665	1,000	0.1%	6
Clean NS (6 municipalities)	43,065	197	0.5%	4
Average			**0.7%**	**6**
Private homes in			315,845	

Ottawa				
5yr Uptake Estimate*			**2,355**	

* Assumes program uptake is expedited to 5 years from the average of 6 due to urgency and learning from leaders

Table 3 Retrofit Program Scale Up Projections based on Energy Evolution Targets

Dwelling Type	Total Dwellings	Retro by 2030*	Retro by 2040*
Single-detached: 45%	173,283	35,090	127,363
Semi-detached: 7%	26,955	5,458	19,812
Row: 21%	80,866	16,375	59,436
Total	**385,074**	**77,977**	**283,029**

* Assumes 75% of retrofits will use LIC financing

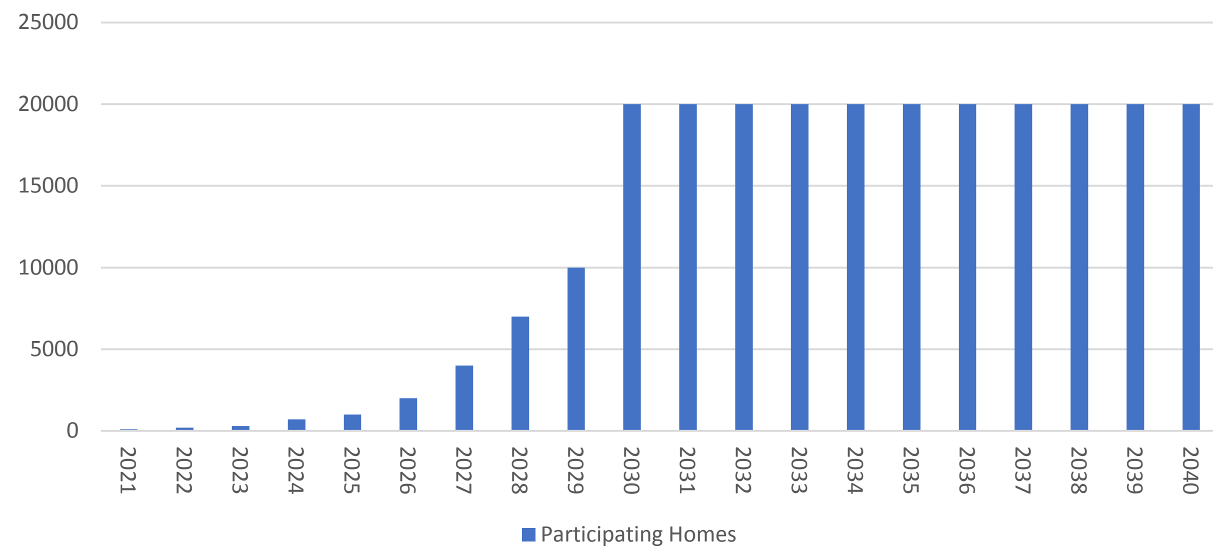


Figure 9 Annual Participation Targets based on Energy Evolution Targets

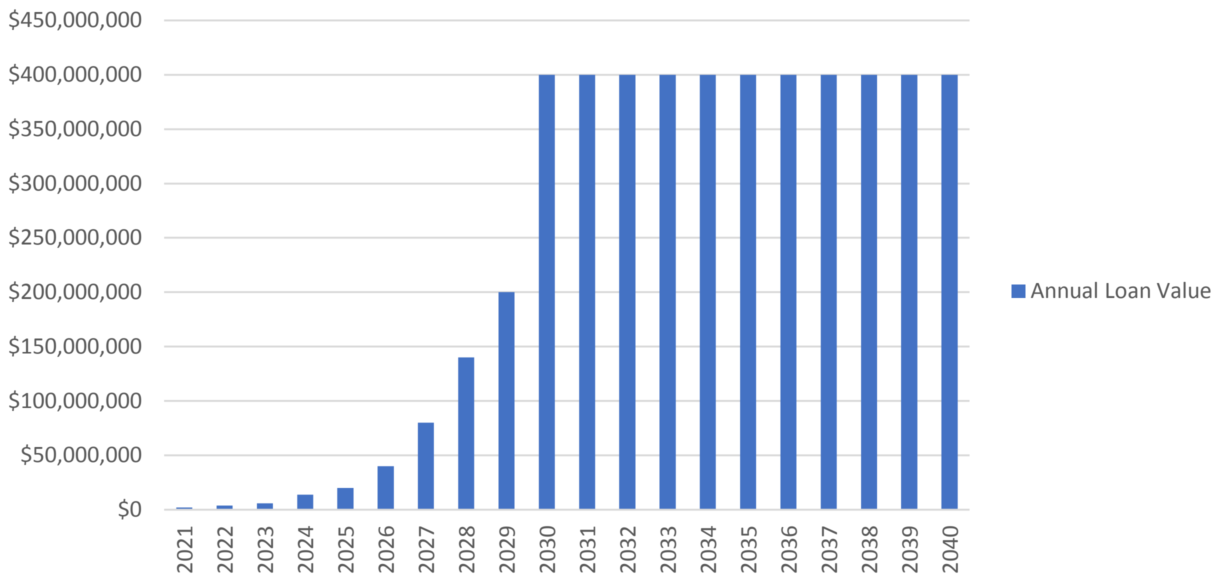


Figure 10 Annual Capital Requirements based on Energy Evolution Targets

Financial assumptions used to model the business case to finance the scale of retrofits projected are provided in Table 4.

Table 4 Financial Assumptions

City Debenture 20-year rate	2.62%
FCM 20-year Loan Interest Rate	2.5%
Interest rate to Homeowner (0.25% over debenture rate)	3.62%
Average years of repayment*	20
Total # payments (years*12 months)	240
Inflation rate on expenses	2%
Average LIC Loan	$20,000
Program Management Staffing (FTE)	1.5
Collections Staff per 500 participants (FTE)	~0.5

* Loan terms will be different depending on technologies implemented

Based on this financial analysis, the net cost per participant arrives at close to $0 once the program reaches maturity (estimated at 300 participants annually), in keeping with the non-profit approach of municipal services (see Figure 11). The program is also designed to maintain a positive cashflow while reinvesting all surpluses into incentives for participation. The cumulative cashflow projection is shown in Figure 12.

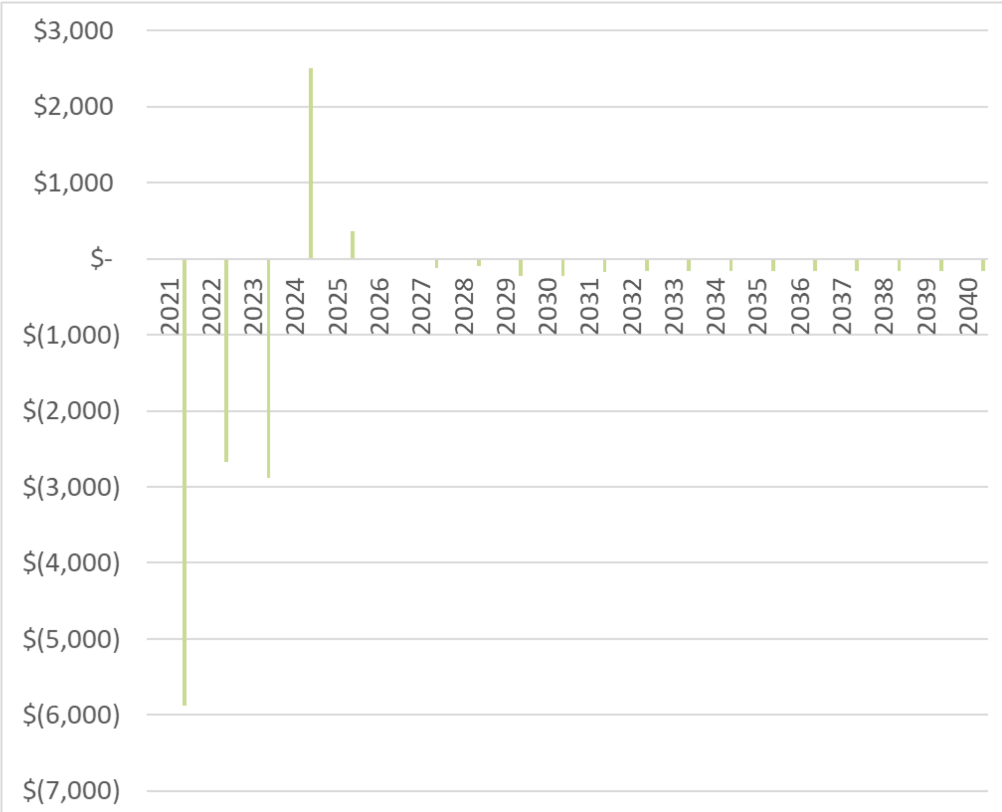


Figure 11 Net Cost per Household Participating

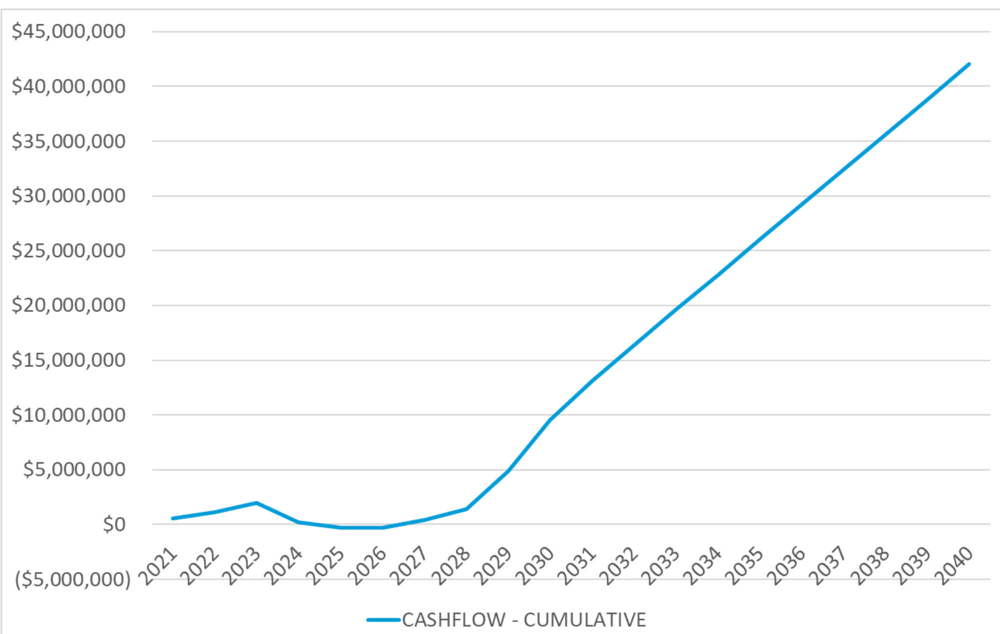


Figure 12 Cashflow Projections

2.3 Type and Location of Buildings to Retrofit

To assess where retrofits might be most effective, an analysis was done of energy saving potential at the neighbourhood level. Generally, older homes have higher potential for energy savings. To facilitate analysis, the homes 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

They were also categorized by dwelling type, namely single houses, duplexes, row homes, and small apartments (up to 4 stories), as shown in Figure 13. It shows that singles and row homes are the most common in Ottawa.

The split of homes of each dwelling type by vintage are shown in Figures 14 to 17.

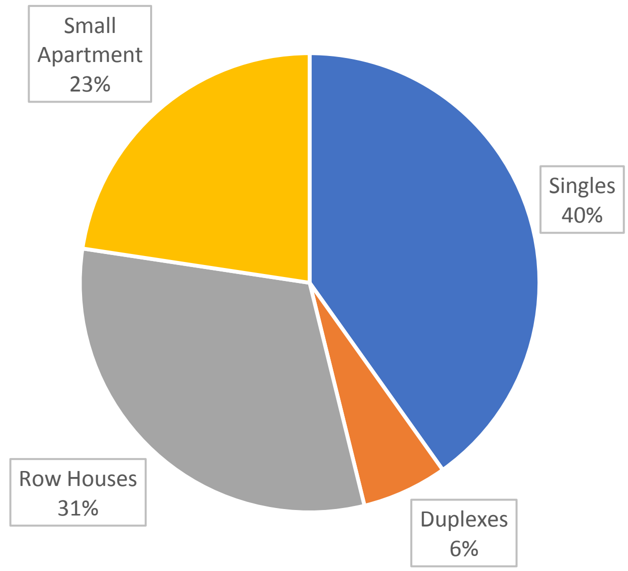


Figure 13 Homes by Dwelling Type

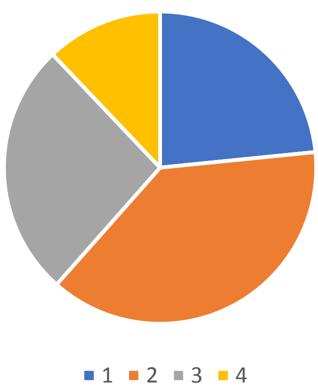


Figure 14 Single Homes by Vintage

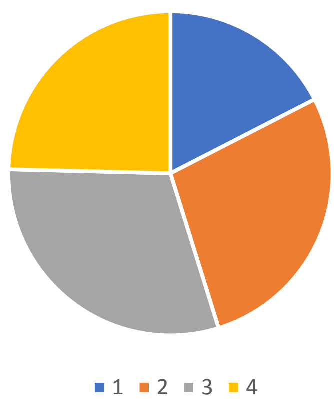
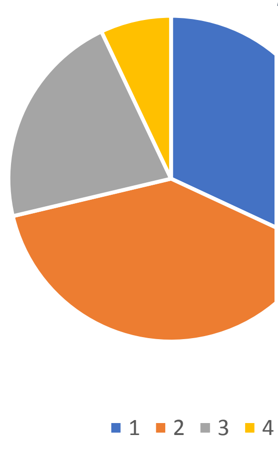


Figure 15 Duplexes by Vintage



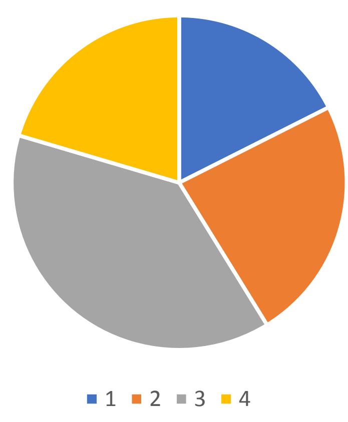


Figure 17 Row Homes by Vintage

Figure 16 Small Apartments by Vintage

Given that the EnerGuide energy auditing and labeling program will be used as the assessment tool for this program and given that it does not accurately capture small apartments, the launch of this program will focus on the three other dwelling types. A second phase of the program will aim to include apartments and other rental buildings that will require a different approach to retrofitting.

As shown in Figures 14 and 15, the most common vintage in singles and rows is Vintage 2 1980 to 2004. Based on the energy performance of the homes, however, the biggest opportunity for energy savings is in the older homes, those in Vintage 4. The two sections pulled out in Figure 18 will be the buildings of focus for the initial phase of the Better Homes Loan Program.

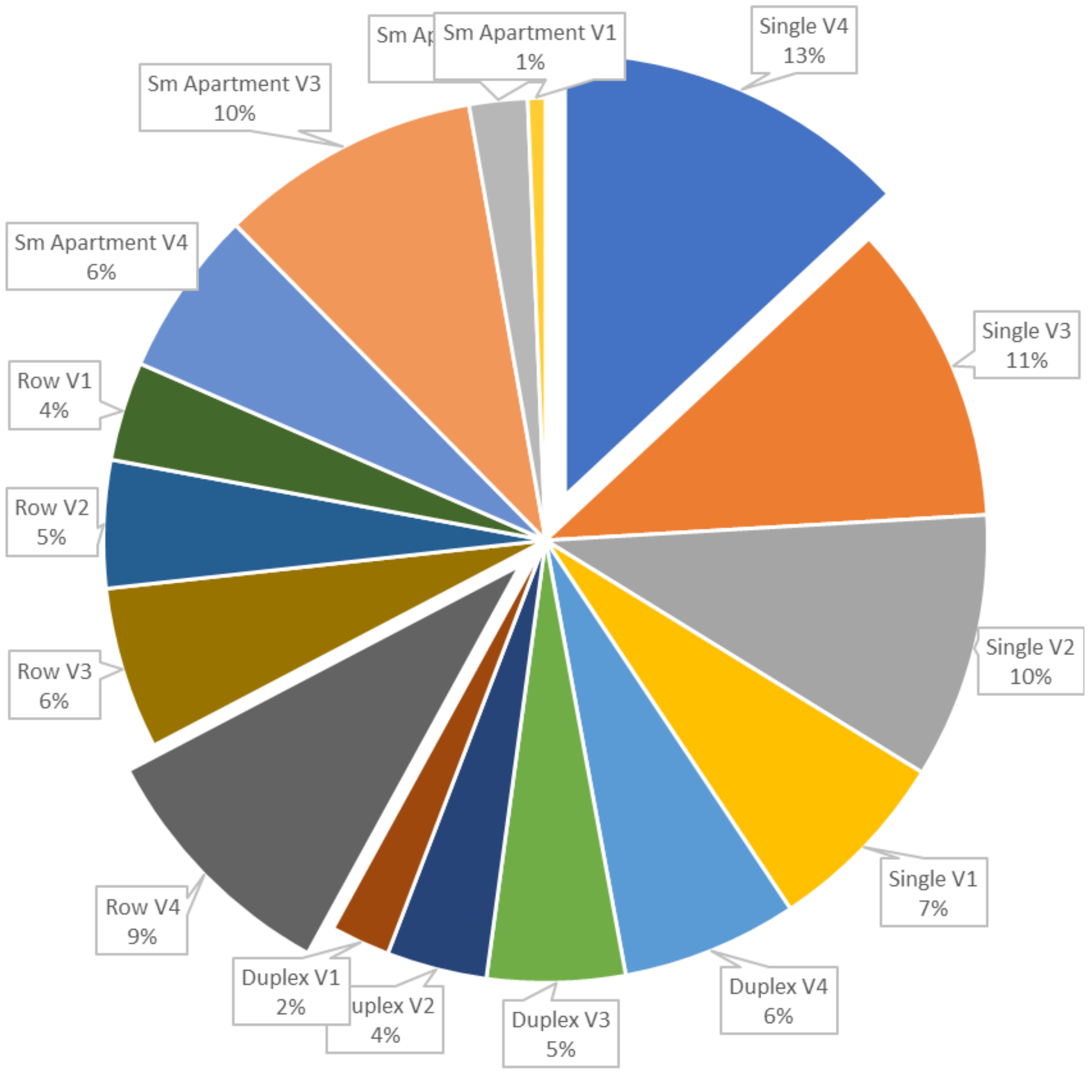


Figure 18 Energy Saving Potential per Dwelling Type and Vintage

Based on the experience in other municipalities, the following demographic conditions lead to higher uptake of retrofit programs[3]:

- Above average utility-calculated natural gas and electricity end-use consumption;
- Above average number of pre 1980 building vintages and uniform building types;
- Higher than average ratio of owner-occupied versus rental properties;
- Varying demographic and socio-economic characteristics (i.e. low-income neighbourhoods); and

[3] https://www.cleanairpartnership.org/wp-content/uploads/2020/05/FINAL-LIC-TOOLKIT-Accelerating-Home-Energy-Efficiency-Retrofits-Through-LIC-Programs-2020-1.pdf

- Existing community initiatives or organizations interested in being aligned with the Program to achieve efficiencies in terms of program delivery (i.e. marketing and outreach support).

The transportation zones with the highest density of older single and row homes were identified. Next, the demographic data from the Ottawa Neighbourhood Study was added to identify thee zones with high levels of home ownership as well as those in need of major repairs. Then, the zones that fell in the intensification areas as identified by the Official Plan were removed because they are more likely to see redevelopment with increased density. The zones in Table 5 are proposed to be the priority areas for initial program marketing and outreach efforts, however, the program will remain open to all homeowners in Ottawa if they choose to apply.

Table 5 Priority Neighbourhoods for Better Homes Loan Program Outreach

Traffic Zone	Neighbourhood	Ownership	Major Repairs Needed	Average Home Value
	Ottawa Total	65.7	5.3	
Row Houses				
1031	Manor Park	48.2	10.0	$790,976
820	Old Ottawa South	73.6	7.0	$737,481
1062	Overbrook - McArthur	39.0	11.1	$332,688
1002	Lindenlea - New Edinburgh	53.9	6.8	$675,480
621	Glebe-Dows Lake	52.7	6.7	$809,158
743	Sandy Hill	25.3	7.1	$586,470
533	Centretown	22.6	7.2	$556,213
721	Byward Market	32.7	5.6	$490,165
810	Old Ottawa East	48.6	4.8	$743,757
Single Homes				
1232	Rothwell Heights - Beacon Hill North	83.7	3.7	$452,091
1900	Chapel Hill South	90.9	2.1	$355,948
2621	Whitehaven – Queensway Terrace North	48.5	8.6	$377,227
2840	Crystal Bay – Lakeview Park	84.0	4.2	$421,019
2272	Braemar Park - Bel Air Heights - Copeland Park	64.2	5.0	$422,713
1720	Hunt Club East - Western Community	60.2	5.2	$583,122
2130	Parkwood Hills - Stewart Farm	15.9	4.8	$475,515
2160	Cityview - Crestview - Meadowlands	66.4	5.7	$428,357
1562	Elmvale - Canterbury	60.1	6.6	$379,086
Total				

2240	Carlington	34.4	11.7	$360,487
2302	Civic Hospital-Central Park	67.9	5.0	$742,921

2.4 Potential GHG Emission Reductions

To assess potential GHG emission reductions, staff used analysis from Energy Evolution that found GHG emissions were 3.6tCO2e per household in 2018. If a retrofit reduces emissions by 30%, as seen in other municipalities, the reductions per retrofit will average 1.1tCO2e. This is the initial estimate for the program as it is what has been achieved in other jurisdictions, however, in order to meet the GHG reductions in Energy Evolution, the per-retrofit carbon reductions will need to ramp up to achieve effectively net zero carbon emissions, which will be achieved through incentivizing or requiring higher performing retrofits. An increased penetration of renewable electricity on the grid and renewable natural gas in the pipeline will also facilitate the realization of these targets.

The different GHG emissions reductions possible at the 30% reduction level versus the 100% reduction level is depicted in Figure 19.

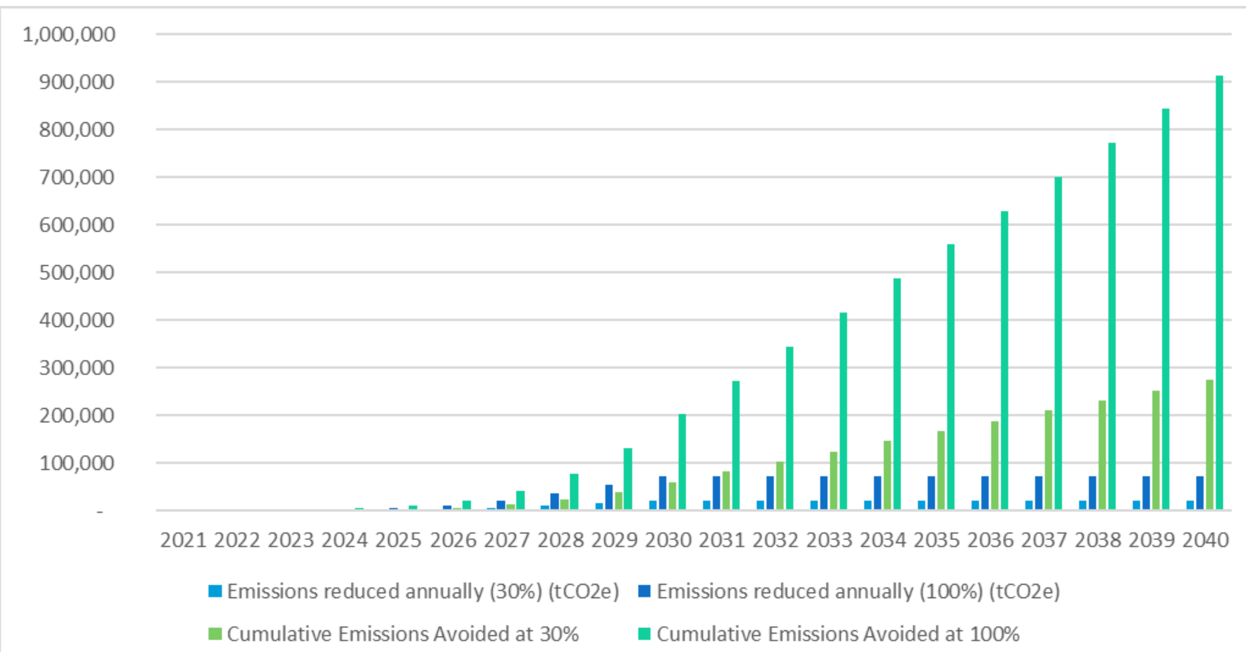


Figure 19 Emissions reductions possible from the retrofit program

2.5 Co-benefits and Co-harms

There are "collateral benefits" (called co-benefits) of emissions reductions from buildings and energy sources. 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 6.

Table 6 Co-benefits and Co-harms Associated with Building Actions in the 100% Scenario

1. Health			
Co-benefits/ co-harms	Impact overview	Buildings	Energy
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 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. Economic prosperity			
2.1 Employment	New employment opportunities are created.	Improved: new jobs will be created in retrofit fields, as well as in new construction, as a result of enhanced building codes.	Improved: new jobs will be created in supplying, installing, and maintaining solar PV, heat pumps, district energy, biogas, and energy storage.

2.2 Household disposable incomes	The impact on household incomes is mixed.	Improved: household energy costs decline.	Improved: household energy costs decrease as a result of improved efficien cy
2.3 Economic develop ment	New economic sectors emerge.	Improved: new investment opportunities in retrofits and new builds.	Improved: new investment opportunities in renewable energy and district energy. Additionally, energy dollars will stay within the city with local generation.
2.4 Municipal finances	Municipal finances associated with existing services are more stable; New services are required. Mobilisation of capital is required to finance the actions.	Unknown: conditi onal on the policies and mechanisms to support retrofits.	Improved: opportunities to generate financial returns from renewable energy generation.
2.5 Innovation	The 100% scenario will stimulate innovation.	Improved: scaled up approaches to renovations, retrofits, and green building technology.	Improved: mass deployment of renewable energy systems.
2.6 Reputation	Ottawa’s reputation is enhanced.	Improved: high performance buildings are further developed in Ottawa.	Improved: renewable energy and district energy improve Ottawa’s reputation as a climate leader.
2.7 Social capital	People interact more as a result of mixed-use development and increased walking		

	and cycling.		
2.8 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.
3. Social equity			
3.1 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.
3.2 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.
3.3 Children	Accessibility for children increases. The built environment is healthier.	Improved: buildings offer healthier and more	

		resilient environments	
3.4 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.

2.6 Conclusion

Based on the ability:

- To bundle retrofit measures so that they are not only feasible, but potentially profitable;
- For the City to develop a financially sustaining LIC program;
- To target initial marketing and outreach efforts to homeowners that are most likely to benefit from the program; and
- To generate significant co-benefits associated with the retrofit of residential buildings;

Staff recommend that Ottawa launch a new LIC program called the Better Homes Loan Program to make it easier and more affordable for homeowners to pay for home energy improvements that contribute to meeting the City's GHG emission reduction targets, create jobs in the contractor, trades, and renovation sectors and make the building stock more comfortable, healthy, and resilient to extreme weather events.

Appendix A: Energy Use and GHG emissions by Fuel Type, Building Type, and Household

In 2016, 48.2% of GHG emissions in Ottawa came from buildings, with residential buildings contributing 27.5%[4]. These emissions are primarily from natural gas consumption, as shown in Figure 20. By switching to electricity and reducing overall consumption, the model for 100% Scenario anticipates GHG emissions will be reduced by 99% in residential buildings by 2050 due to the low GHG emission grid in Ontario (Figure 21).

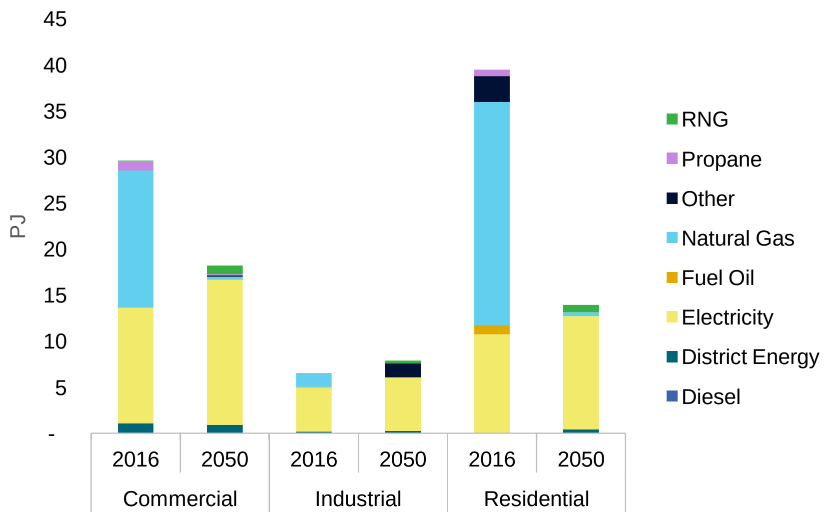


Figure 20 Energy use by fuel and building type, 2016 and 2050

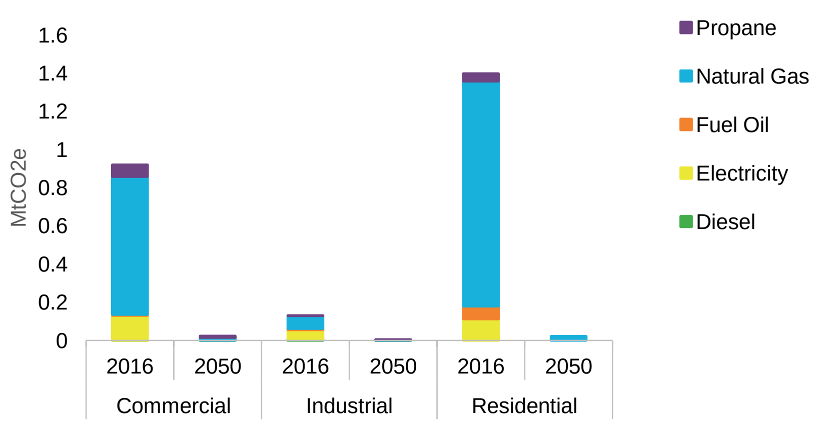


Figure 21 GHG emissions by building type and source, 2016 and 2050.

[4] In 2018, the residential share of emissions was 22%.

The use of energy and GHG emissions in residential buildings is dominated by space heating in 2016. The next most significant energy use and emissions is water heating, as seen in Figures 22 and 23.

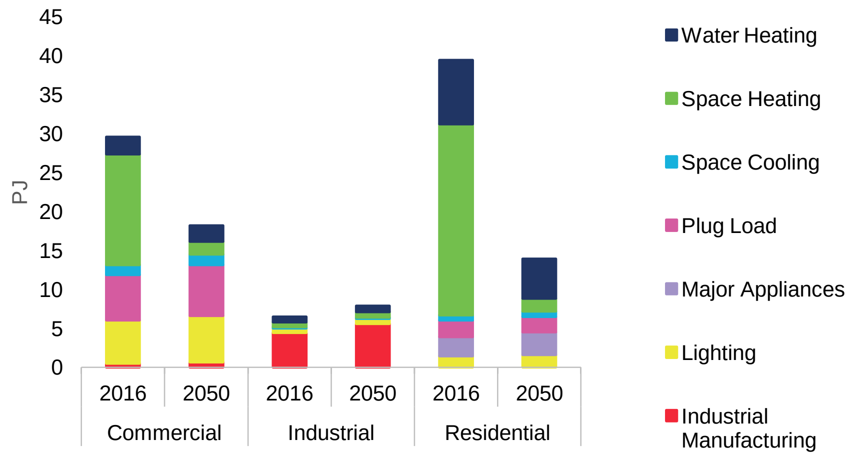


Figure 22 Energy use by building type and end use, 2016 and 2050.

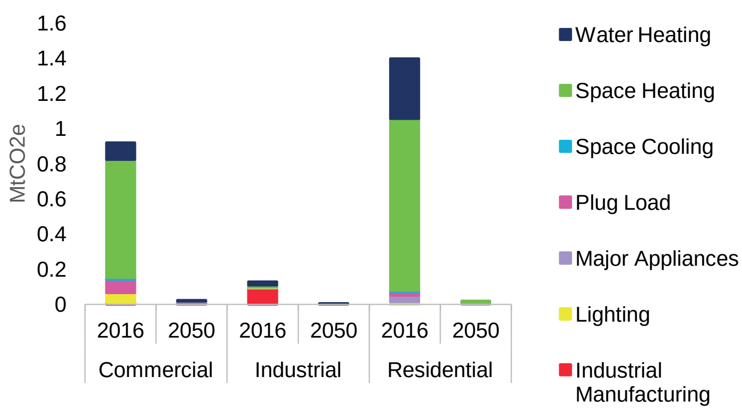


Figure 23 GHG emissions by building type and end use, 2016 and 2050.

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

When analyzing the low carbon pathway for the residential sector, energy use per household declines from 105.6 GJ to 23.4 GJ between the baseline in 2016 and the 100% in 2050, a reduction of 78%, as shown in Figure 24. Household energy use in 2050 in the BAP scenario is projected to be lower than in 2016 due to building code improvements, asset replacement at end of life, trends towards smaller units, and decreased heating degree days, therefore the incremental energy reductions called for in the 100% scenario compared to BAP in 2050 is 64%, as depicted in Figure 24.

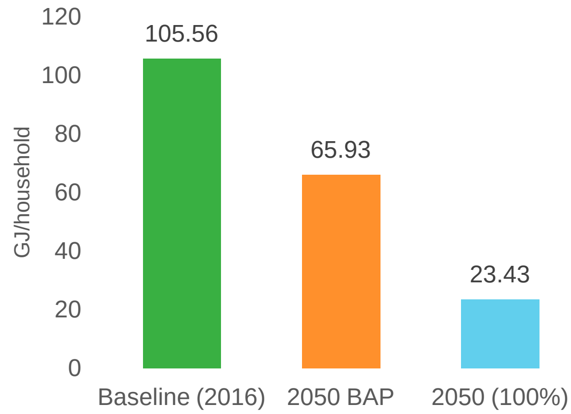


Figure 24 Residential energy per household, 100% scenario.

On the emissions side, residential GHGs decrease by 98.5% on a per household basis by 2050. These savings are a result of retrofits to existing buildings to maximize energy efficiency, net-zero standards for new dwellings, adoption of energy-efficient heating sources, and fuel switching away from fossil fuels, as shown in Figure 25.

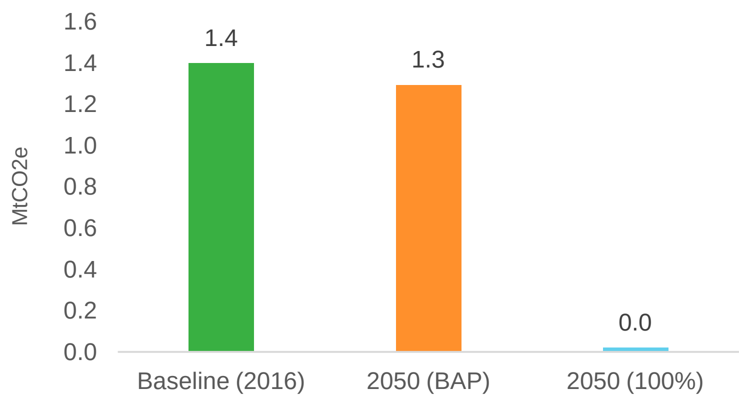


Figure 25 Residential emissions per household, 2016 and 2050.