TOWN OF HALTON HILLS

Town of Halton Hills
2020-2025 Corporate Energy Plan

July 2019

This 2020-2025 Corporate Energy Plan was prepared for the Town of Halton Hills by Enerlife Consulting Inc. It meets the requirements of Ontario Regulation 507/18, which requires Ontario's broader public sector organizations to develop and publish an Energy Conservation and Demand Management (ECDM) Plan every 5 years.

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1 EXECUTIVE SUMMARY

Together with a growing number of big cities and smaller municipalities across North America and around the world, the Town of Halton Hills (the Town) is taking action to substantially reduce and ultimately eliminate greenhouse gas (GHG) emissions associated with the municipality's corporate facilities and operations. On May 6, 2019, the Town of Halton Hills Council issued a Climate Change Emergency Declaration that points to the need to reduce overall net emissions to zero by 2030. This accelerates the requirement for planning, development and implementation of strategies to achieve deep emissions reductions. This Corporate Energy Plan (the Plan) provides the strategy and roadmap for the period 2020-2025 which will lay the foundations for achieving the Town's longer-term goals.

The Plan is transformational, not just for facilities and vehicles but also for how the Town conducts its business and operations. Every aspect of decision-making should be subject to a no/low-carbon filter affecting the products and services the Town buys, the facilities and services operated and the roles and responsibilities of management and employees. The period from 2020 to 2025 should be a foundation-laying period with an emphasis on alignment of management systems and organizational capacity-building, and on early wins to build experience, confidence and momentum.

The Town is building on its prior successes and existing good practices. In particular, benchmarking indicates that the energy efficiency of the Town's corporate facilities is relatively good compared with other municipalities. The Town has working experience with geothermal installations which are considered key to the no/low-carbon future. The Town's leading Corporate Asset Management program and Corporate Sustainable Building Policy are strong existing platforms into which needed carbon reduction policies, processes and standards can be incorporated.

The focus of the Plan is on getting the best out of the Town's existing assets, capital planning and organizational strengths while investing in facility upgrades with the best emissions reduction potential and highest returns on investment. The aim is to systematically introduce no/low-carbon decision-making while demonstrating substantial emissions reductions which position the Town on the right trajectory towards its goals.

The Plan presents a three-part approach to the progression towards the goal of deep reductions in carbon emissions. The first part is investment in energy efficiency retrofits and operational improvements to corporate facilities which provides a good return on investment. As detailed in Section 3 Portfolio Energy Optimization Strategy, the Plan proposes an investment of $2,676,000 in energy efficiency upgrades to Town facilities over the 5-year period, including addition of building automation technology across all buildings. This investment would be offset by over $250,000 in forecast utility company incentives (rebates). When the measures are fully implemented, the reduced energy and water consumption will generate utility cost savings estimated at more than $400,000 per year at current rates. This work would proceed in phases, beginning in 2020, prioritizing facilities with the best

energy savings potential and those where renewal projects are already planned. Annual progress reporting will verify savings achieved, document lessons learned and refine the planning for the subsequent year.

Second, as outlined in Section 6.2 Long-Term Capital Planning, all new buildings, major renovations and equipment replacements should be planned and implemented to achieve low or no-carbon performance. The Town's Corporate Asset Management program and sustainable building policies will support comprehensive high-performance, low-carbon targets and design, with every capital project subject to these requirements. Additional time and capital to incorporate low carbon design will be included in each project. The proposed retrofit of Gellert Community Centre is an ideal pilot for developing and testing the overall approach, applied to the whole facility, not just the expansion, to create integrated low-carbon design and operations. Similarly, the fleet management strategy will progressively incorporate carbon reduction practices and programs to support low-carbon vehicles, operations and commuting.

The third part of the overall strategy is proactive, long-term investment in geothermal, advanced heat recovery, and renewable energy installations designed to minimize natural gas consumption and associated emissions. Section 4 Renewable/Low-Carbon Energy Procurement Strategy provides details of this approach. Where such investments do not yet meet the Town's economic criteria, capital renewal and replacement projects should be designed to be ready for future installations as technology continues to advance and economics improve. Grants from senior levels of government will be pursued to help fund these projects.

Recommendations:

1. Take a systematic, evidence-based approach to developing low-carbon facilities, operations and organizational capacity. Develop low-carbon standards, practices and management systems through currently planned capital projects and targeted high-potential retrofits before committing to major capital investments.
2. Focus first on understanding and making the most of existing facilities and operations. Testing and analysis of individual building systems, effective documentation, staff training, and performance-based service contracts can bring them to optimal performance and keep them running efficiently in future. Applying this approach to ventilation, ice plants and other systems is recommended as part of the Corporate Asset Management Program.
3. Continue and conclude the investigation into the operation of the Town's 4 existing geothermal installations to get them operating at their full potential while informing the Town standard for future installations as an essential element of the carbon reduction goal.
4. Halton Hills has an exemplary Corporate Asset Management Program that takes a whole lifecycle approach to realizing value in each of the Town's service areas. Integration of low-carbon considerations and procedures is recommended, particularly during the Needs Identification and Assessment stage and in monitoring performance and costs throughout the physical asset life cycle from initial planning to final disposal.
5. New buildings and major renovations should be designed for climate change adaptation and a low-carbon future, taking into consideration:
    a. High-performance energy efficiency and net-zero carbon design and operations

   b. Renewable energy
   c. Low-carbon transportation opportunities
   d. Climate resilience and survivability, including high-performance building envelopes, protecting or enhancing natural drainage systems, infrastructure (particularly water storage), flood defences and standalone energy supply based on renewables and bio-fuel generators

6. Investment in upgrading existing facilities should prioritize those with high emissions reduction potential and returns on investment while extending the application of building automation technology and developing standardized approaches to operations and maintenance.
7. Make the best use of the current fleet and resources by collecting data on current fleet practices. Prepare for technological advances in new vehicles and fleet management and expand electric vehicle adoption as these become available.

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- Michael Dean, Senior Sustainability Planner & Energy Coordinator, Town of Halton Hills
- Gabriel Clarke, former Manager of Sustainability & Climate Change, Town of Halton Hills
- Art Skidmore, CEO and President, Halton Hills Hydro
- Linda Boyer, Conservation and Demand Management Officer, Halton Hills Hydro
- Cara Jarv, Business Services Manager, SouthWestern Energy
- Dharmen Dhaliah, Corporate Asset Manager, Town of Halton Hills
- Duncan Robertson, Budgets and Financial Reporting Supervisor, Town of Halton Hills
- Steve Hamilton, Manager of Facility Capital Projects, Town of Halton Hills
- Matthew Lynch, Fleet Coordinator, Town of Halton Hills
- Simone Gourlay, Manager of Purchasing, Town of Halton Hills
- Geoff Cannon, Chief Librarian, Halton Hills Public Library
- Bruce Morrison, Deputy Fire Chief, Halton Hills Fire Department
- Matthew Roj, Traffic Coordinator, Town of Halton Hills
- John Linhardt, Commissioner of Planning and Sustainability
- Maureen Van Ravens, Manager of Transportation and Development Engineering
- Deanna Locey, Transit Supervisor

LIST OF ACRONYMS

- AHU – air handling unit
- AVL – automatic vehicle location
- BAS – building automation system
- CAM – Corporate Asset Management
- CEP – Corporate Energy Plan
- CO2e – carbon dioxide equivalent
- CSBP – Corporate Sustainable Building Policy
- DCFC - direct current fast charger
- DHW – domestic hot water
- ECDM – energy conservation and demand management
- ekWh – equivalent kilowatt-hours (electricity and natural gas use converted to equivalent units, or natural gas use converted to equivalent units)
- ekWh/sf – total energy (electricity and gas in equivalent kilowatt-hours) or gas use (converted to equivalent kilowatt-hours) per square foot of facility floor space
- EUI – energy use intensity, measured in kWh/sf (electricity) and ekWh/sf (natural gas, and electricity and natural gas combined)
- EV – electric vehicle
- FCM – Federation of Canadian Municipalities
- GHG emissions – greenhouse gas emissions measured in tonnes CO2e
- GRF – green revolving fund
- GSHP – ground-source heat pump
- HVAC – heating, ventilation and air conditioning
- ICEV - internal combustion engine vehicle
- IRR – internal rate of return
- kWh – kilowatt-hours of electricity
- LED – light-emitting diode
- M&V – monitoring and verification
- MUA – make-up air unit
- NPV – net present value
- O&M – operations and maintenance
- PCP – Partners for Climate Protection
- ROI – return on investment
- RTU – roof-top unit
- VFD – variable frequency drive

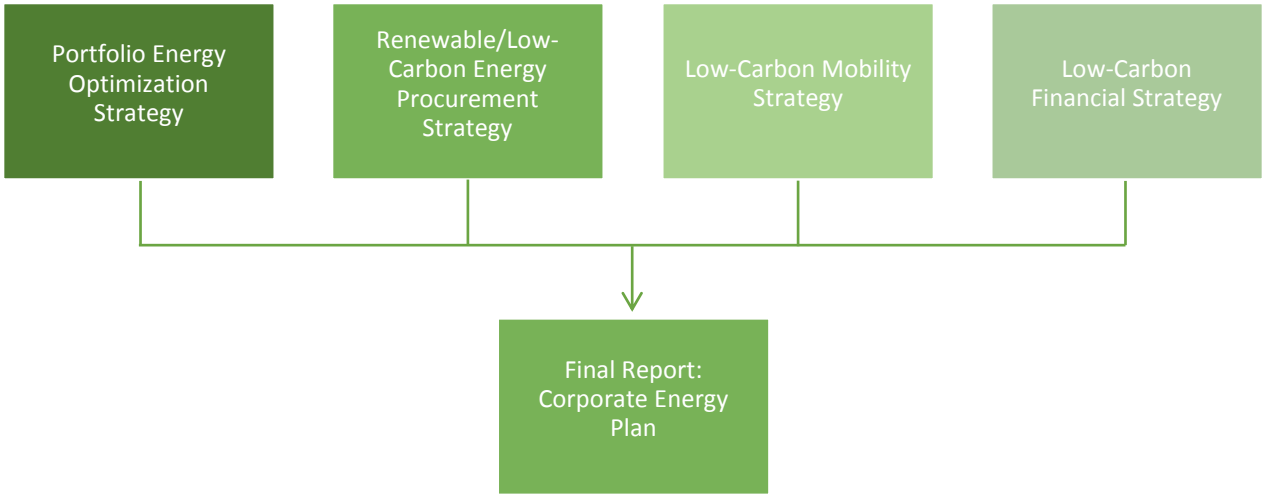
2 INTRODUCTION

Ontario's broader public sector organizations are required to develop and publish an Energy Conservation and Demand Management (ECDM) Plan every five years. Adhering to provincial regulation, in 2014 the Town of Halton Hills (the Town) prepared its first five-year ECDM plan covering the period from 2014-2018, known as the Corporate Energy Plan.

This 2020-2025 Corporate Energy Plan (the Plan) constitutes the Town's second ECDM plan. It updates the 2014 Plan and reaffirms the Town's commitment to energy management and efficiency with an emphasis on deep greenhouse gas (GHG) emissions reductions. It reports on achievements to date and outlines the approach to managing energy in Town facilities over the next five years. The 2020-2025 Plan goes beyond the regulatory requirement in outlining the approach to achieving a low-carbon vision by developing four connected foundational strategies:

1. Portfolio Energy Optimization to minimize facility energy consumption while upgrading buildings and maintaining or improving occupant comfort;
2. Renewable/Low-Carbon Energy Procurement to increase the Town's use of renewable energy;
3. Low-Carbon Mobility to address emissions resulting from the Town's vehicle fleet and employee commuting; and
4. Low-Carbon Financial Strategy aimed at developing a comprehensive funding approach to fully enable the Plan's implementation.

Figure 1 Four strategies of the 2020-2025 Corporate Energy Plan



2.1 About Town of Halton Hills

The Town of Halton Hills is a lower-tier municipality in the Regional Municipality of Halton, located in the northwestern end of the Greater Toronto Area, Ontario, Canada, with a population of 61,161 (2016). The largest population centres are Georgetown and Acton.

The Town of Halton Hills has built a strong reputation as a leader in energy and emissions management. Development of high efficiency new buildings and an energy conservation ethos among staff and facility managers, together with implementation of renewable and alternative energy projects has brought quality of life benefits to employees and residents while significantly reducing utility costs associated with Town operations. The efforts are directed and driven by an active Corporate Energy Team which consists of the Office of Sustainability and departmental representatives.

2.2 Objectives of the 2020-2025 Corporate Energy Plan

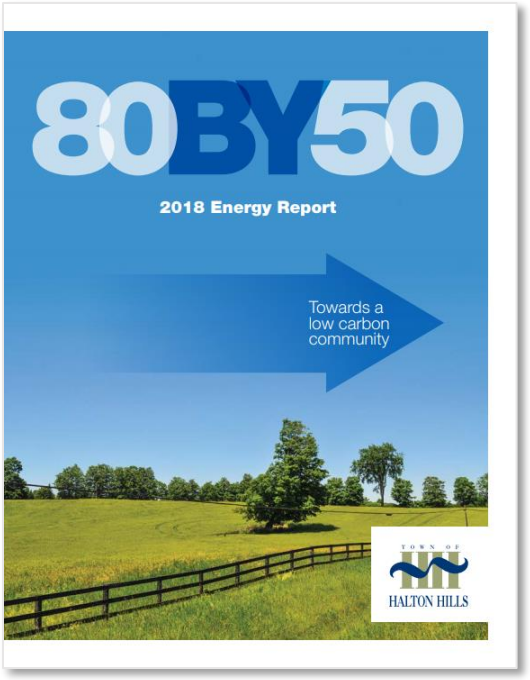
In November of 2017, Town Council adopted emissions reduction targets which aim for an 80% reduction in emissions by 2050. More recently, on May 6, 2019, Council issued a Climate Change Emergency Declaration and set a goal to become a net zero municipality by 2030. Central to this commitment is leadership by example, with the Town demonstrating exceptional performance through its own facilities, fleet and operations.

Achieving this goal requires a radical rethink of every aspect of planning, procurement, design and operations. The new Plan builds on successes to date, while implementing actions to deepen energy and emissions reductions and build organizational capacity to deliver and sustain improvements. Each of the strategies in the Plan was developed in consideration of this goal. Successful implementation will benefit current and future generations and create pride and inspiration across the community through delivering measurable results.

The Plan will also enable the Town to complete Milestones 4 and 5 of the Federation of Canadian Municipalities' Partners for Climate Protection (PCP) Program, while creating investment and employment opportunities across the community.

2.3 Development of the 2020-2025 Corporate Energy Plan

As part of the Plan development process the Town convened a project management team and a steering committee. The steering committee was comprised of members of the existing Corporate Energy Management Team and other important stakeholders. This body met at key points throughout the development process to provide input, subject matter expertise and feedback. In addition to bi-weekly project management meetings, consultation with department representatives gathered their input and advice. These focused, strategy-specific meetings included two with fleet operations, one with asset management and finance, and one with Halton Hills Hydro to discuss electric vehicle charging stations and other collaboration opportunities. A Corporate Energy Plan update workshop, which included the Corporate Energy Team as well as Corporate Services representatives, was held on June 18, 2019.



2.4 Results from the Past 5 Years

The 2014 Corporate Energy Plan focused on lowering the Town's natural gas, electricity and vehicle fuel consumption, increasing the use of low-carbon technologies and supporting the use of renewable energy. That plan set a goal of 16.7% energy intensity reduction (electricity and natural gas use per square foot of floor space to account for growth in building areas). In 2018, the Town prepared a comprehensive Energy Report, outlining the status of the 85 actions of the 2014 Corporate Energy Plan, including priority actions (2014-2015), medium-term actions (2015-2017), and long-term actions (2017-2019).

To continue this principle of transparency, the Town is preparing a Current Conditions Report which includes a review of energy use trends over the past five years, as well as additional details on projects implemented and other actions undertaken to date. The Current Conditions Report is expected to be published along with this 2020-2025 Corporate Energy Plan and will be posted on the Town's website.

3 PORTFOLIO ENERGY OPTIMIZATION STRATEGY

Benchmarking shows that the Town's buildings are relatively energy efficient compared against similar facilities owned by other municipalities (see Appendix A: Comparison with Other Facilities). This good performance is attributed to a high level of operational practices. The further energy and emissions reductions presented in the Plan will come from equipment testing and upgrades, retrofits to equipment and expanded use of building automation. The Corporate Energy Team and Asset Management program are the cornerstones of the platform through which higher efficiency will be achieved and sustained over time. The strategy starts with an overview of the current and targeted energy use intensities for the Town facilities. The combined costs, savings and incentives from the recommended measures are summarized in the form of a cashflow model included at the end of this section.

The overall approach is summarized as follows:

- Conclude the testing and investigations into the existing geothermal systems and get them all working as intended. Develop a corporate standard for future geothermal installations in other buildings which are considered essential to reaching the Town's carbon reduction goals
- Continue targeted testing and analysis to determine operating performance of building systems and equipment and identify areas for improvement
- Invest in retrofits and operational improvements, prioritizing the high-savings potential buildings identified in the Plan
- Prepare low carbon design briefs (see Appendix F: Low-Carbon Design Brief) for existing buildings to ensure that no/low carbon options are considered for every capital project to avoid conventional designs for facility renewals and expansions and like-for-like equipment replacements. Pilot this approach with the planned major renovation of the Gellert Community Centre
- Update corporate standards to incorporate design (such as equipment selection and system power density) and operational (such as HVAC scheduling and temperature set-point) standards
- Set and meet high-performance energy and emissions targets for all new buildings and expansions

3.1 2018 Energy and Emissions Baseline and Energy Savings Potential

Table 1 presents the 2018 energy use, costs, and greenhouse gas emissions for Town facilities.

Table 1 Town of Halton Hills 2018 energy use, costs, and GHG emissions, by facility

Facility	2018 Energy Use (ekWh)	GHG Emissions (tonnes CO2e)	2018 Utility Costs ($)
Prospect Park Pavilion	**60,846**	**6**	**$ 5,512**
Electricity	33,976	1	$ 4,534
Natural Gas	26,870	5	$ 978
Acton Yard - Equipment Depot	**136,412**	**22**	**$ 5,819**
Electricity	16,535	0	$ 2,413
Natural Gas	119,877	22	$ 3,406
Acton Library Branch	**139,048**	**6**	**$ 16,366**
Electricity	118,784	2	$ 15,554
Natural Gas	20,264	4	$ 812
Cedarvale Community Centre	**200,344**	**34**	**$ 8,271**
Electricity	15,876	0	$ 2,800
Natural Gas	184,468	34	$ 5,471
District One Station (Acton)	**372,736**	**48**	**$ 22,628**
Electricity	128,440	3	$ 16,137
Natural Gas	244,296	45	$ 6,491
District Three Station - HHFD HQ	**335,270**	**23**	**$ 34,304**
Electricity	235,068	5	$ 31,460
Natural Gas	100,202	18	$ 2,844
District Two Station (Georgetown)	**375,271**	**29**	**$ 35,679**
Electricity	244,130	5	$ 32,062
Natural Gas	131,141	24	$ 3,617
Halton Hills Cultural Centre and Library	**743,218**	**20**	**$ 123,794**
Electricity	709,560	14	$ 122,644
Natural Gas	33,658	6	$ 1,150
Town Hall	**861,208**	**64**	**$ 112,956**
Electricity	578,520	12	$ 104,744
Natural Gas	282,688	52	$ 8,212
Robert C Austin Operations Centre	**1,315,482**	**171**	**$ 98,736**
Electricity	429,120	9	$ 75,581
Natural Gas	886,362	162	$ 23,155
Acton Arena	**2,791,889**	**302**	**$ 266,638**
Electricity	1,284,171	26	$ 227,534
Natural Gas	1,507,718	276	$ 39,104
Gellert Community Centre	**3,641,765**	**523**	**$ 225,736**
Electricity	888,438	18	$ 155,318
Natural Gas	2,753,327	505	$ 70,418
Mold-Masters SportsPlex	**6,042,825**	**648**	**$ 566,248**
Electricity	2,811,451	56	$ 484,230
Natural Gas	3,231,374	592	$ 82,018
Total	**16,950,368**	**1,895**	**$ 1,522,687**

Site-specific high-performance energy targets have been developed for each facility based on benchmarking against similar buildings in the Mayors' Megawatt Challenge program[1] database. These targets can generally be met through cost-effective retrofits and good facility operations.

Table 2 shows the energy, utility cost and emissions reductions to be achieved through meeting these targets and serves to quantify the overall savings potential through energy efficiency improvements while identifying the highest-potential buildings.

Table 2 Energy use, targets, and savings potential (sorted by GHG emissions reduction potential)

Facility	2018 Total Energy Use Intensity, ekWh/sf	Target Total Energy Use Intensity, ekWh/sf	Total Energy Savings Potential, %	Total Energy Savings Potential, $/yr	GHG Emissions Reduction Potential (tonnes CO2e)
Mold-Masters SportsPlex	38.26	24.06	37%	$176,771	256.9
Gellert Community Centre	80.82	51.81	36%	$27,508	204.0
Acton Arena	29.30	22.75	22%	$22,688	102.7
Robert C Austin Operations Centre	53.25	33.83	36%	$39,754	58.4
District One Station (Acton)	33.05	12.52	62%	$12,550	34.5
District Two Station (Georgetown)	24.12	8.94	63%	$22,236	26.3
Town Hall	22.17	15.05	32%	$32,814	23.4
District Three Station – HHFD HQ	22.38	8.94	60%	$22,167	13.8
Acton Yard – Equipment Depot	54.99	25.89	53%	$1,743	12.9
Cedarvale Community Centre	14.22	9.28	35%	$1,420	10.5
Halton Hills Cultural Centre and Library	14.83	9.75	34%	$40,809	8.3
Acton Library Branch	16.02	9.58	40%	$7,644	3.7
Prospect Park Pavilion	12.71	7.08	44%	$4,593	0.5
TOTAL				**$412,696**	**756**

Note that numbers may not add up to totals due to rounding.

3.2 Facility Site Visits

Site visits were conducted at six Town facilities to confirm energy targets, document equipment and systems and identify the operational and retrofit measures required. Facilities selected for the site visits had high estimated greenhouse gas reduction potential. One facility with geothermal was additionally selected, as this will be a key component of the carbon reduction strategy going forward. Halton Hills Cultural Centre and Library was added to the list as it has potential for electricity savings. The six buildings are as follows:

- Acton Arena
- Gellert Community Centre
- Mold-Masters SportsPlex

[1] Mayors' Megawatt Challenge (MMC) is a network of municipalities that features events, benchmarking and assessment reports, on-going energy and water reporting, analytical tools, and awards and recognition.

- Town Hall
- Halton Hills Cultural Centre and Library
- District Three Station – HHFD HQ

3.3 Recommended Energy Efficiency Measures

This analysis identifies, assesses and prioritizes projects and develops implementation budgets to guide the allocation of funding and resources. Project-level economic analyses across the portfolio link to the Low Carbon Financial Strategy (Section 7) and support evaluation of possible pathways to net-zero energy for buildings. The aim is a phased implementation of deep energy retrofit and operational strategies that can deliver economic, environmental and occupant well-being benefits.

Table 3 summarizes the recommended measure types, their estimated budget costs, savings, and paybacks. The following subsections provide the details of recommended measures. The overall budget for energy efficiency measures for all buildings is derived from the measure types, costs and savings for the six audited buildings, applied across the whole portfolio. Summaries of measures proposed for each of six audited facilities are provided in Appendix B: Details of Energy Efficiency Measures.

Table 3 Summary of recommended energy efficiency measures by measure type

Measure type	Estimated Cost ($)	Electricity Savings (kWh/year)	Gas Savings (m3/year)	Estimated Savings ($/year)	Incentives ($)	Payback (years)	GHG emissions reduction (tonnes CO2e)
Lighting	$353,387	340,669	0	$57,914	$34,067	5.5	6.8
HVAC & Controls Retrofits	$2,082,243	1,277,223	258,688	$283,947	$179,460	6.8	521.2
Operations	$110,478	175,200	102,499	$56,259	$38,020	1.3	199.9
Building Envelope[2]	$105,728	64,366	14,068	$14,576	$9,250	6.6	28.2
Training	$24,000	0	0	0	0	0	0
TOTAL	**$2,675,836**	**1,857,459**	**375,255**	**$412,696**	**$260,797**	**6.4**	**756**

Note that numbers may not add up to totals due to rounding.

3.3.1 Lighting

Independent lighting audits are recommended to ensure correct product selection, light levels and power densities. The audits will avoid overlit spaces and generally result in a reduction in fixtures, ballasts, lamps and electricity use and lower long-term maintenance costs. The audits record existing fixtures, ballasts and lamps and specify the most appropriate LED replacement. They measure existing light levels and power densities (Watts/sf) for each space and the equivalent for the proposed replacement. Power densities should generally fall between 0.1-0.4 Watts/sf for most space types.

[2] Window replacements at Town Hall (estimated cost of $160,000) are not considered for implementation within the 5-year term of this Plan but are in the Capital Plan.

The auditor will identify fixtures which are in poor condition and need replacement and where re-circuiting is recommended to maximize the potential for scheduling and controls and connect excessive emergency lighting fixtures to general lighting circuits.

3.3.2 Heating, Ventilation and Air Conditioning (HVAC) and Controls

Performance testing of all HVAC systems is recommended to establish operating flow rates, pressures and power consumption. This applies to air handling and hydronic systems, dehumidifiers and domestic hot water systems and would include either trend logs from the building automation system or data-logging to determine how efficiently the equipment is operating in different seasons. Analysis of test results identifies the specific system improvements necessary to deliver the savings in each building.

The testing also identifies malfunctioning equipment in need of repair or replacement, any system design flaws, damage and leaks requiring refurbishment which can update the Corporate Asset Management program, be included in the retrofit projects or dealt with through the Town's maintenance program.

Plant and equipment testing by specialized contractors, including boilers and refrigeration equipment, is recommended to determine efficiency, operating performance and opportunities for improvement. Ventilation re-balancing and refurbishment includes setting supply, return and exhaust air volumes to match current requirements, together with equipment and system repair and replacement as identified by the testing contractor.

Installation of destratification fans in high-bay areas is recommended where they are not presently installed to improve comfort and reduce space heating requirements by pushing warm air down from the ceiling to the occupied zone.

Variable Frequency Drives (VFDs) are recommended for all fans and pumps which do not have them, prioritizing larger motors with longer operating periods and significant daily and seasonal load variations. VFDs typically provide the greatest electricity and utility cost savings in buildings and allow accurate control of airflows and air balance to avoid drafts, outside air infiltration and associated occupant discomfort.

3.3.3 Process Equipment

Optimization of ice plant efficiency is centred on matching ice temperature and thickness to daily programming requirements and ensuring efficient compressor and pump operation. This work can include replacement of controllers and sensors, re-balancing pumps and re-programming operating sequences, as well as correcting inefficiencies identified through testing (currently underway at Mold-Masters SportsPlex ice plant).

Optimization of swimming pool equipment centres on efficient operation of the dehumidifier and circulating pump and on control set-points and programming. Inefficiencies identified through testing will be corrected and water and space temperature and humidity set-points maintained in accordance with Town standards. See Appendix E: Sample Setpoint Policy for Pools for a sample setpoint policy for pools which focuses on reducing energy use as well as meeting standards for operation.

3.3.4 Building Envelope

Thermographic scans of building exteriors are recommended with the building under positive pressure to identify elements with high conductive heat loss and excessive air leakage.

Local draft-proofing and re-insulation is implemented as necessary to reduce heat losses and improve occupant comfort.

3.3.5 Building Automation Systems (BAS)

Installation of new BAS is recommended for every building which does not yet have one, beginning with the largest facilities having the greatest energy savings potential. While the Town's buildings are generally running efficiently when compared against other municipalities, it will be difficult to sustain high performance and achieve the further improvements without the benefit of current automation technology. A new Town standard is recommended which specifies the level of functionality (and associated investment) required for different facility types and sizes. All systems will support archiving of trend logs and remote access for monitoring and programming changes.

Integration of ice plant controls with the BAS and the Town's program scheduling software will be implemented to streamline operations and maximize energy savings. Table 4 summarizes the proposed BAS installations, upgrades and HVAC optimization costs.

Table 4 Summary of proposed BAS installations, upgrades and HVAC optimization costs

Facility Name	Estimated Costs	Area sq ft	Comments
Mold-Masters SportsPlex	$362,000	151,000	BAS installation for HVAC equipment & web/central control for ice plant controls (includes costs for optimization)
Gellert Community Centre	$226,000	38,000	Upgrade Trane Supervisory Control for 7 rooftop units and install BAS that will include all the equipment
Acton Arena	$232,000	92,000	BAS installation for HVAC equipment & web/central control for ice plant controls (includes costs for optimization)
Robert Austin Operations Centre	$95,625	25,000	Additional sensors to be installed, reset strategies based on performance testing
District One Station (Acton)	$33,408	11,136	Mini BAS Installation for better controls and scheduling
District Two Station (Georgetown)	$15,934	15,934	Based on performance testing. Includes additional sensors - recommissioning of the existing system and implementation of optimization strategies
Town Hall	$212,000	40,000	Additional sensors to be installed; BAS installation
District Three Station - HHFD HQ	$17,088	13,616	Additional sensors to be installed; recommissioning of the existing system
Acton Yard - Equipment Depot	$10,000	2,400	BAS installation
Cedarvale Community Centre	$34,500	11,500	BAS installation
Halton Hills Cultural Centre and Library	$69,185	50,500	Based on performance testing and implementation of optimization strategies including BAS reprogramming
Acton Library Branch	$68,850	9,000	Based on performance testing and implementation of optimization strategies including BAS reprogramming
Prospect Park Pavilion	$14,400	4,800	BAS installation
TOTAL	**$1,390,990**		

Note that numbers may not add up to totals due to rounding.

3.3.6 Geothermal Installations

Geothermal heating and cooling systems extract heat from the ground in winter and reject the heat from air conditioning back into the ground in summer, providing efficient heating and cooling while substantially reducing or eliminating use of natural gas and the associated greenhouse gas emissions. This technology is considered necessary for the Town to meet its carbon reduction goals. The Town has

4 existing installations, two in District Three Station - HHFD HQ and District Two Station (Georgetown) and the other two in the Acton Library Branch and the Halton Hills Cultural Centre and Library.

The fire station systems have experienced severe operational problems from the outset, including equipment failure and replacement. Investigations have led to addition of supplementary heating and cooling plant, and these systems do not provide the intended heating and cooling efficiencies.

Geothermal systems are a central strategy for meeting the Town's carbon reduction goals. Further work is recommended on all four existing installations aimed at maximizing performance and developing design and operational standards for future installations in other Town facilities. Testing includes pump flow rates and hydronic balance as well as data-logging system operation in different seasons. Design schematics and capacities and operation of heat pumps will be documented. The fire station systems need to be repaired or replaced to meet the particular operating requirements of this building type. A preliminary budget allocation of $100,000 is proposed for this testing, investigation, documentation, analysis, and training, which will lead to a best practice application, design and operations guide for use with existing and future installations.

Future costs for geothermal system upgrades and possible replacement have not been determined or included in the Plan. External funding from governments and utility companies will support this work.

3.4 Phasing of Work and Annual Implementation Costs

The table below presents an initial distribution of project costs over the 5-year term of the Plan.

Table 5 5-year implementation plan

Category	Estimated Total Budget	Measure Type	Facility Name	Estimated Cost ($)	Year 1	Year 2	Year 3	Year 4	Year 5
					2020	2021	2022	2023	2024
Lighting	$353,387	Lighting Audits	Mold-Masters SportsPlex	$9,060			$9,060		
			Acton Arena	$5,520			$5,520		
			Robert C Austin Operations Centre	$3,000			$3,000		
			District One Station (Acton)	$2,673			$2,673		
			District Two Station (Georgetown)	$2,868			$2,868		
			District Three Station - HHFD HQ	$2,451			$2,451		
			Halton Hills Cultural Centre and Library	$6,060			$6,060		
			Acton Library Branch	$2,700			$2,700		
		Lighting Projects - Recommended Measures	Mold-Masters SportsPlex	$181,200				$181,200	
			Acton Arena	$55,200					$55,200
			Robert C Austin Operations Centre	$18,000					$18,000
			District One Station (Acton)	$8,018					$8,018
			District Two Station (Georgetown)	$8,604				$8,604	
			District Three Station - HHFD HQ	$7,353					$7,353
			Halton Hills Cultural Centre and Library	$36,360				$36,360	
			Acton Library Branch	$4,320					$4,320
HVAC & Controls Retrofits	$2,082,243	HVAC Performance Testing	Mold-Masters SportsPlex	$24,000	$24,000				
			Gellert Community Centre	$16,000	$16,000				
			Acton Arena	$14,000	$14,000				
			Robert C Austin Operations Centre	$9,500	$9,500				
			District One Station (Acton)	$4,454	$4,454				
			Town Hall	$15,350	$15,350				
			Acton Yard - Equipment Depot	$5,000			$5,000		
			Cedarvale Community Centre	$2,500			$2,500		

Category	Estimated Total Budget	Measure Type	Facility Name	Estimated Cost ($)	Year 1	Year 2	Year 3	Year 4	Year 5
					2020	2021	2022	2023	2024
			Prospect Park Pavilion	$1,500			$1,500		
		HVAC & Controls Retrofit	Mold-Masters SportsPlex	$615,768	$153,942		$153,942	$123,154	$184,731
			Gellert Community Centre	$244,000	$122,000	$122,000			
			Acton Arena	$254,080	$76,224	$76,224	$101,632		
			Robert C Austin Operations Centre	$112,625	$28,156			$28,156	$56,313
			District One Station (Acton)	$58,353	$58,353				
			Town Hall	$253,800	$126,900	$126,900			
			Acton Yard - Equipment Depot	$11,392			$11,392		
			Cedarvale Community Centre	$41,630			$41,630		
			Halton Hills Cultural Centre and Library	$121,020	$30,255	$30,255	$15,128	$15,128	$30,255
			Acton Library Branch	$79,890	$39,945	$19,973	$19,973		
			Prospect Park Pavilion	$30,624					$30,624
		System Evaluation + Design Specification development	District Two Station (Georgetown)	$100,000	$20,000	$80,000			
			District Three Station - HHFD HQ						
			Halton Hills Cultural Centre & Library						
			Acton Library Branch						
		Optimization of Systems	District Two Station (Georgetown)	$36,768			$36,768		
			District Three Station - HHFD HQ	$29,989			$29,989		
Operations	$110,478	Ice Plant Optimization	Mold-Masters SportsPlex	$36,995		$36,995			
			Acton Arena	$23,767		$23,767			
		Pool Optimization	Gellert Community Centre	$49,717		$49,717			
Building Envelope	$105,728	Building Envelope	Mold-Masters SportsPlex	$30,200				$30,200	
			Gellert Community Centre	$7,600				$7,600	
			Acton Arena	$18,400				$9,200	$9,200
			Robert C Austin Operations Centre	$5,000			$5,000		
			District One Station (Acton)	$2,227					$2,227
			District Two Station (Georgetown)	$3,187			$3,187		
			Town Hall	$8,000			$8,000		

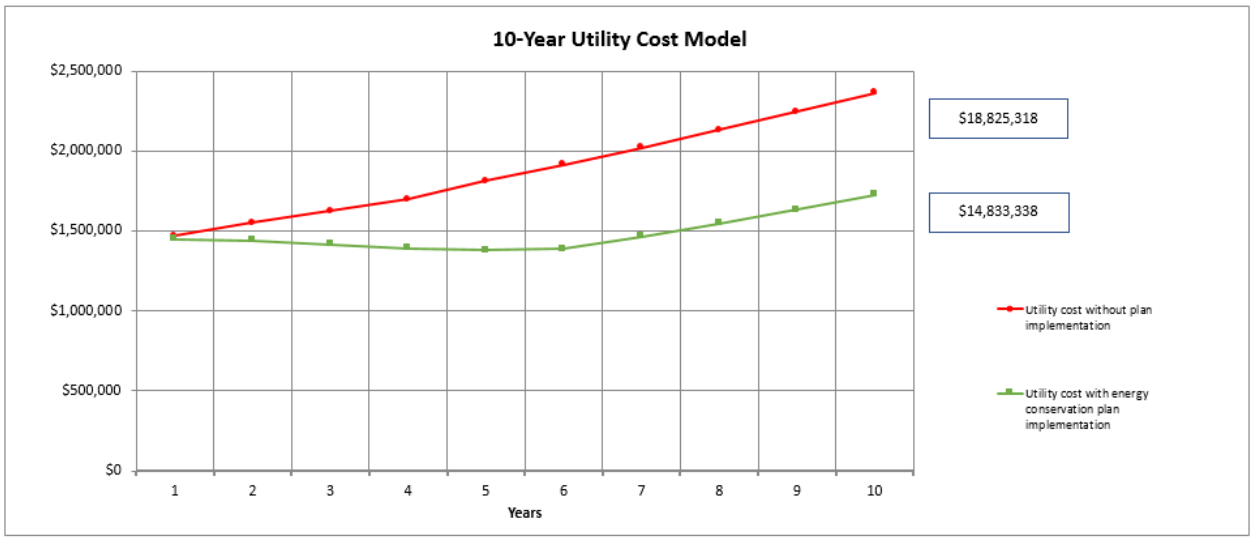
Category	Estimated Total Budget	Measure Type	Facility Name	Estimated Cost ($)	Year 1	Year 2	Year 3	Year 4	Year 5
					2020	2021	2022	2023	2024
			District Three Station - HHFD HQ	$2,723			$2,723		
			Acton Yard - Equipment Depot	$2,400				$2,400	
			Cedarvale Community Centre	$2,300				$2,300	
			Halton Hills Cultural Centre and Library	$10,100			$10,100		
			Acton Library Branch	$11,191			$11,191		
			Prospect Park Pavilion	$2,400				$2,400	
Training	**$24,000**	**Staff Training**		$24,000			$24,000		
	$2,675,836		**TOTAL**	**$2,675,836**	**$739,079**	**$565,830**	**$517,986**	**$446,702**	**$406,240**

3.5 Financial Forecast

3.5.1 Utility Cost Forecast

Figure 2 shows the 10-year annual utility cost forecast for the Town' existing portfolio of buildings, with and without implementation of the recommended energy efficiency measures, based on implementation as outlined in the previous section.

Figure 2 Utility cost forecast over the next 10 years

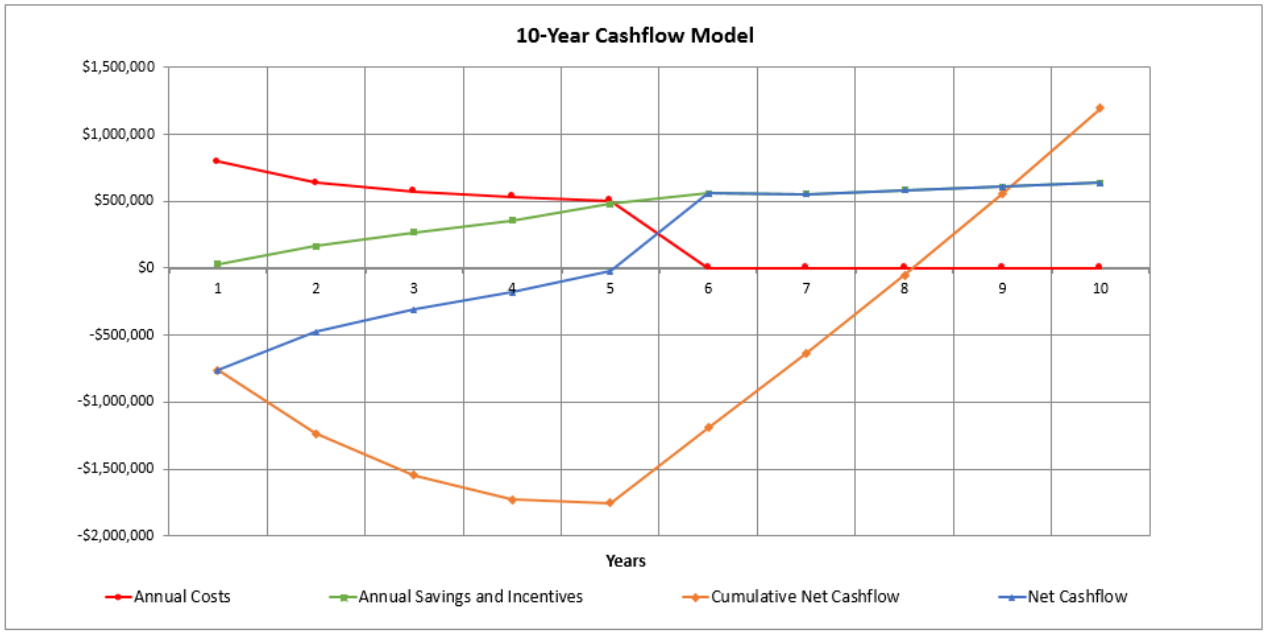


With current utility price escalation forecasts, the Town's annual utility costs can be expected to rise from $1.47 million in 2018 to $2.37 million in 2028, for a ten-year total spend of $18.8 million. Implementation of the measures recommended under the Portfolio Energy Optimization Strategy is projected to lower that expenditure by almost to $4 million over 10 years.

3.5.2 Cash Flow and Internal Rate of Return

The cashflow model in Figure 3 and Table 6 below includes energy efficiency project costs, energy savings and utility incentives, together with an allowance of $50,000/year for external resources required to support implementation (Implementation Support costs). The model provides an internal rate of return of 9%.

Figure 3 Cashflow model



The 10-year costs, savings, and incentives, including cost inflation and utility price escalation, are summarized below. Financial model assumptions are included in Appendix C: Data Assumptions.

Table 6 Cashflow model

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Total
Project costs	$747,598	$585,355	$524,073	$483,115	$452,254	$0	$0	$0	$0	$0	$2,792,395
Implementation support costs	$50,000	$51,250	$52,531	$53,845	$55,191	$0	$0	$0	$0	$0	$262,816
Total cost (with inflation)	**$797,598**	**$636,605**	**$576,604**	**$536,959**	**$507,445**	**$0**	**$0**	**$0**	**$0**	**$0**	**$3,055,211**
Incentives	$12,787	$53,530	$58,151	$50,973	$50,674	$34,681	$0	$0	$0	$0	$260,797
Savings	$20,232	$109,223	$208,809	$306,743	$432,159	$527,452	$554,443	$582,597	$610,426	$639,896	$3,991,980
Incentives + Savings	**$33,019**	**$162,753**	**$266,961**	**$357,716**	**$482,834**	**$562,133**	**$554,443**	**$582,597**	**$610,426**	**$639,896**	**$4,252,777**
Cumulative Net Cashflow	-$764,579	-$1,238,432	-$1,548,075	-$1,727,318	-$1,751,929	-$1,189,796	-$635,353	-$52,756	$557,669	$1,197,565	
Net Cashflow	-$764,579	-$473,853	-$309,644	-$179,243	-$24,611	$562,133	$554,443	$582,597	$610,426	$639,896	

Note that costs and savings include escalation rates as listed in Appendix C: Data Assumptions.

3.6 Performance Indicators

The Town is already tracking its energy and environmental performance and reports on progress internally and externally. The following additional performance indicators are recommended as the most relevant, easily managed and measured metrics that will be effective over the long term.

a. Monthly energy data tracking – *already being done*
b. Energy savings – measuring progress against targets on an annual basis ($ cost savings)
c. Number of buildings/systems under BAS control
d. Targeted number of energy efficiency measures achieved and progress vs the target
e. Greenhouse gas emissions reduction (absolute, %)

4 RENEWABLE/LOW-CARBON ENERGY PROCUREMENT STRATEGY

On May 6, 2019, Town Council issued a Climate Change Emergency Declaration that included a goal of becoming a net zero municipality by 2030. Use of low-carbon/renewable energy will help move the Town towards the achievement of that goal. Ontario has the advantage of low-carbon electricity, shifting the focus of carbon reduction programs to natural gas and gasoline. The heart of the low-carbon energy supply strategy is to minimize, and where practical eliminate, combustion of fossil fuels in buildings and vehicles (addressed in Section 5). With the current low price of natural gas, life-cycle economic analysis which factors in future expectations for carbon pricing is necessary to make the business case.

4.1 Onsite Renewable/Recoverable Energy

The Town's first priority is energy efficiency – making the Town's current systems and existing buildings as efficient as possible – which offers a good return on investment. Adding onsite energy recovery and renewable energy is initially more costly and generally provides a lower return on investment, particularly for existing buildings. Advances in technology together with carbon pricing and utility rate escalation can be expected to improve these economics over time. The Town's sustainability policies can direct their inclusion in new buildings and major renovations and be regularly updated as technology and economic conditions change, as discussed in Section 7.2. Standalone renewable energy projects should be evaluated alongside other opportunities based on their cost-effectiveness in delivering GHG emissions reductions.

4.1.1 Heat Recovery

The first stage of low-carbon energy supply in buildings is to recycle internally generated heat. Electrical rooms and computer suites, dehumidification of pool enclosures and ice rinks and heat reclaim from refrigeration compressors (already in place for new arenas) are natural candidates. Recovering heat from exhaust air and waste-water discharge can also be considered where heating and ventilation systems are redesigned wherever practical to recover heat which is now discharged to drain or to atmosphere. Air-source heat pumps, which extract heat from outdoor air, can displace gas consumption in HVAC units and to replace window air conditioners and local electric heaters.

4.1.2 Geothermal

The Town already uses ground-source heat pump (GSHP) installations, which extract heat from the ground during the heating season and replace it in summer with the heat output from the air conditioning cycle. GSHP technology brings the added benefit of more efficient air conditioning which lowers peak electrical demand in summer months. Studies to date indicate that ground conditions in Halton Hills are favourable for GSHP installations.

To further reduce gas consumption, GSHP installations should be considered for all buildings. For existing buildings, this will call for deep retrofits where the existing HVAC system would be replaced with heat pumps and a geothermal field of horizontal or vertical boreholes. Such retrofits fall outside the scope of this plan and their costs are not included in the financial forecast. Given the cost of GSHP

installations, the most economically viable applications will be where substantial parts of the existing system have reached end of life and avoided replacement costs offset the capital investment in the project, or in new construction projects.

4.1.3 Solar Photovoltaics

There is limited potential for generating substantial amounts of energy through solar photovoltaics on rooftops of Town facilities due to high costs and the invasive nature of retrofitting existing buildings with solar arrays. No new facilities are currently planned over the next 5 years, but the Town should consider requiring that every new facility either include solar PV generation, or be solar-ready with the necessary wiring. This requirement can be extended to the wider community, beyond Town facilities (and beyond the scope of this Corporate Energy Plan), and opportunities can be explored to provide incentives to the community to increase solar energy generation.

The Town recently completed a solar streetlighting pilot project in partnership with Wenjiang, Halton Hills' Sister City in China. The Town will continue to take advantage of such partnerships as and when the opportunity arises.

Rooftop solar photovoltaic systems have been installed in 3 facilities at the Town of Halton Hills, as listed in the table below, and generate approximately 1 megawatt (MW) of electricity per year. This can power between 150 – 210 homes per year.

Table 7 Halton Hills Community Energy Corporation – Solar Array System Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kWh)
11620 Trafalgar – Robert C Austin Operations Centre (100 kW FIT 4.0)													
2017								16,713	16,093	11,154	6,420	4,721	55,101
2018	6,232	6,136	14,475	13,776	19,334	18,304	19,498	15,422	13,133	8,151	3,637	3,761	141,859
2019	6,568	6,277	11,860	12,117	13,058	16,643							66,523
Subtotal													263,483
221 Guelph St, Georgetown – Mold-Masters SportsPlex (450 kW FIT 3.0)													
2017													0
2018	13,019	20,559	58,518	62,432	89,455	86,094	92,503	70,225	53,835	31,719	10,721	12,893	601,973
2019	20,754	20,729	41,229	52,667	66,507	86,619							288,505
Subtotal													890,478
415 Queen St, Acton - Acton Arena (200 kW FIT 4.0)													
2017							40,513	41,901	37,028	22,842	11,406	8,845	162,535
2018	11,305	11,829	33,754	34,283	48,948	47,546	51,032	39,856	31,039	18,008	5,245	6,309	339,154
2019	12,730	10,184	26,657	26,468	36,794	47,658							160,491
Subtotal													662,180
												Total since installation:	**1,816,141**
												2018 total:	**1,082,986**

4.1.4 Solar Thermal

Where practical, new buildings and major renovations will be designed with south-facing ventilation air intakes and "solar wall" preheating.

Solar thermal will be considered for new and existing domestic hot water and pool water heating applications where the life-cycle economics, including utility incentives and forecast carbon pricing, make sense.

4.1.5 Low-Carbon Design Brief

The Low-Carbon Design Brief is a new approach recommended to ensure all capital projects fully consider least-carbon options and avoid like-for-like equipment replacements and conventional designs. It presents the concept, schematic design and plant capacities of near- or net-zero new buildings or those about to undergo a major plant replacement or renovation. For new buildings and major renovations, it would form part of the design team's scope of work. For existing buildings, it would be prepared in advance of major plant and equipment replacements. The Low Carbon Design Brief is described in more detail in Appendix F.

4.2 Alternative Carbon Reduction Approaches

The Town has an option to supplement onsite renewable energy generation with procuring renewable energy through arrangements such as power purchase agreements and renewable energy credits. Based on current emissions, the estimated cost for carbon offsets to mitigate the Town's GHG emissions would be in the range of $125,000 – $145,000 a year. These expenditures would be significant and will only be considered once the opportunities to optimize energy efficiency and onsite renewables and heat recovery are exhausted.

Virtual net metering is a good strategy to encourage production and purchasing of renewable energy within the community. Currently, this strategy is not available to Halton Hills Hydro due to regulatory restrictions. As and when changes to the regulations are considered, this strategy could become available. Although beyond the scope of this Corporate Energy Plan, opportunities can be explored with the Halton Hills Hydro to provide incentives to the community to increase solar energy generation.

4.3 Performance Indicators

The Town is already tracking its energy and environmental performance and reports on progress internally and externally. These additional performance indicators are strategically chosen as the most relevant, easily managed and measured metrics that will be effective over the long term.

a. Renewable energy targets established (% of total energy from renewable sources) and progress against targets measured
b. Share of Town facilities' total energy use that comes from renewable energy
c. Share of existing geothermal systems working optimally or # of facilities running on geothermal
d. Gas use reduction ($ cost savings, %)
e. Greenhouse gas emissions reduction (absolute, %)

5 LOW-CARBON MOBILITY STRATEGY

As part of the connected strategies to address energy and greenhouse gas emissions, this Low-Carbon Mobility Strategy builds upon current initiatives, fleet management and draft Corporate Fleet Management Strategy[3] to address the replacement of current vehicles with low-carbon alternatives, and reduce fuel consumption and emissions in current fleet vehicles and employee commuting. This strategy also looks at the links and interrelationships with other proposed low-carbon strategies, including the Green Development Standards, Corporate Sustainable Building Policy and Community Energy Plan.

This strategy has been developed in consultation with the Public Works Fleet Coordinator, Senior Sustainability Planner and Energy Coordinator, Transit Supervisor, Manager of Transportation and Development Engineering, Corporate Asset Manager, SouthWestern Energy Business Service Manager, and President and Chief Executive Officer of Halton Hills Hydro.

5.1 Background

Transportation is responsible for 28% of Canada's carbon emissions[4] and one of the areas where emissions are increasing year over year. Internal combustion engine vehicles produce greenhouse gas emissions, as well as consume non-renewable resources and create health risks associated with tailpipe pollutants such as carbon dioxide, methane and nitrous oxide.

On May 6, 2019, the Town of Halton Hills Town Council issued its Climate Change Emergency Declaration outlining the need to reduce overall emissions to zero by 2030, with specific references that impact the Low-Carbon Mobility strategy, including the following:

- *Transition the Town's fleet to electric vehicles whenever possible and as soon as possible*
- *The Town encourage staff and the public to switch to plug-in vehicles by installing more EV charging stations at Town facilities beginning with Town Hall, and further strategies (such as preferred parking spots) be considered to encourage the switch to electric and high efficiency vehicles by the public.*

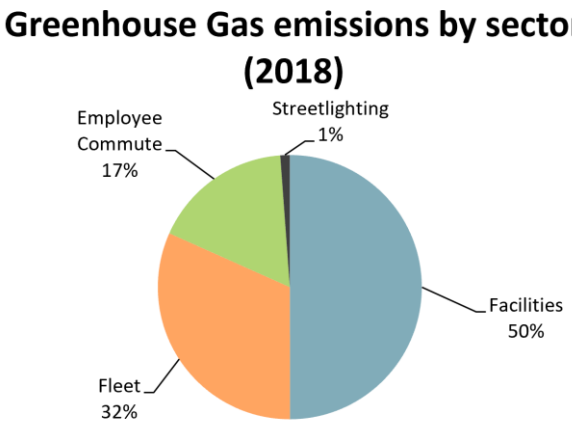
The Town of Halton Hills owns, operates and maintains approximately 213 vehicles and other equipment for the Recreation and Parks, Fire Services, and Transportation and Public Works Departments. These vehicles are essential to maintain roads and parks, manage water and sewer services, and provide many other community services. The large majority of vehicles are powered by diesel fuel or gasoline.

In 2018, fleet vehicle use made up 31.7% (1,298 tonnes of CO2e) of the Town's greenhouse gas emissions. Employee commuting made up 17.2% (702 tonnes of CO2e). The most recent breakdown of greenhouse gas emissions by sector is as follows.

[3] The Town of Halton Hills Corporate Fleet Management Strategy Draft Submission March 13, 2019 by GM Blue Plan Engineering

[4] Greenhouse gas sources and sinks: executive summary 2019 (https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/sources-sinks-executive-summary-2019.html)

Figure 4 Town of Halton Hills Greenhouse gas emissions by sector (2018)[5]



As the town has grown, the fleet size has increased along with greenhouse gas emissions – with a 26.5% (272 tonnes CO2e) increase since the baseline year of the previous Corporate Energy Report (2013). As the population of the Town is expected to continue to grow over the next 5 -10 years, aided by the planned Vision Georgetown development, the mobility segment of emissions will continue to increase as Town services expand, employee numbers rise and more fleet vehicles are required.

The Town has already taken substantive steps to address fleet and commuting emissions. New vehicles are required to be multi-use and "right-sized" – the smallest vehicle possible to do the job required. Diesel vehicles use biodiesel fuel blends with 20% biodiesel (B20) in the summer and 5% biodiesel (B5) in the winter[6]. An electric ice resurfacing machine for the ice rinks has been tested. Electric Vehicle (EV) charging stations have been installed with 14 chargers at Mold-Masters SportsPlex, 2 chargers at Acton Arena and 2 at the Halton Hills Hydro Administration building.

5.2 Approach

The following builds on current successes and existing practices, as well as the recently completed Corporate Fleet Management Strategy, to reduce greenhouse gas emissions from fleet and commuting vehicles.

The primary focus is on making the best of what the Town already owns, setting up organizational structures and processes and developing an integrative plan with set goals. This is particularly critical for low-carbon mobility, as achieving these goals will take time. Low-carbon vehicle technology is developing rapidly but currently there is limited or no product availability for most types of fleet vehicles. Current stock is often in testing stages, only produced by a few manufacturers, has limited features or models and high purchase prices. Some automakers and start-ups are committed to producing electric fleet vehicles but the vehicles will not be available for a few years.[7] When they

[5] Source: 2018 Inventory for Town of Halton Hills

[6] "Biodiesel is diesel fuel made from vegetable oils, animal fats, or recycled restaurant greases. It's safe, biodegradable, and produces less air pollutants than petroleum-based diesel" (Source: US Department of Energy https://www.fueleconomy.gov/feg/biodiesel.shtml).

[7] https://sustainability.ups.com/media/UPS_GreenBiz_Whitepaper_v2.pdf

become available and affordable, the Town will be well positioned to incorporate these options into the fleet.

This strategy focuses on:

- Ensuring organizational readiness for technological advances in new vehicles and fleet management, as well as increases in electric vehicle adoption
- Making the best use of the current fleet and maintenance resources
- Identifying opportunities to replace end-of-life vehicles with electric options, when possible.
- Developing standards, processes and infrastructure to ensure and prepare for a low-carbon/zero carbon

5.3 Planning and Procurement

Set up a Low-Carbon Mobility subcommittee. The mandate of this subcommittee is to determine the low- or zero-carbon mobility goals for the Town, how they impact vehicle purchasing, new facility design and electric vehicle (EV) infrastructure, as well as how ongoing progress towards the goals will be tracked. At minimum, the subcommittee would:

- Coordinate EV charging infrastructure implementation
- Share testing results of low-carbon vehicle technology under consideration and identify implementation implications
- Identify low-carbon mobility maintenance considerations for fleet and EV charging stations
- Identify funding opportunities such as incentives, grants and paid advertising on EV charging stations
- Contribute to the development of a Low-Carbon Design Brief for new facilities, when required, incorporating alternative transportation options, vehicle charging, and operations and maintenance considerations.

This subcommittee could include Fleet management, Fleet maintenance, the Office of Sustainability, Halton Hills Hydro or SouthWestern Energy, and Facility representatives.

Collect data on vehicle use. As recommended in the Corporate Fleet Management Strategy, the first step to greening fleet operations is collecting data and knowledge on how vehicles are used within the Town's fleet, ideally through an automatic vehicle location system which uses global positioning system (GPS) data. This will allow tracking of vehicle use, minutes of idling and tracking routes. Most importantly it will inform how routes can be redrawn to make the most efficient use of vehicles and pinpoint idling reduction opportunities and guide the development of an informed idling reduction policy.

Centralize fleet procurement and cost tracking. This is critical to ensure low carbon fleet options meet the Town's needs, provide the best value and further Town goals. Considerations such as new technology, maintenance and operations will require input from inhouse subject matter experts and fleet users and should be incorporated consistently.

Consider lifecycle cost and low carbon objectives when replacing vehicles. Consideration of lifecycle cost and strategic objectives when fleet vehicles are due for replacement, will help make the case for considering low carbon and electric vehicle options. Although electric vehicles have a higher initial cost, fuel costs and maintenance are significantly lower than internal combustion engine vehicles (ICEVs).

Fuel costs are approximately 60-70% less and maintenance is 30 – 35% less for first 8 years of ownership before battery replacement[8]. Electric vehicles can save approximately $1,800 - $2,500 per year in fuel and maintenance costs and incentives for green vehicle purchases can further reduce the lifecycle cost (as below).

5.4 Greening Current Fleet

Knowing more about how the current fleet operates also provides an opportunity to reduce greenhouse gas emissions. This includes:

Fleet management. Fleet management software will provide the data on how the fleet is used and the opportunity to make sure fleet routes are time and resource efficient. Idling reduction opportunities can also be identified.

Idling reduction policy. An idling reduction policy should be developed, ideally from the information gathered from the fleet management software. The policy will outline specific rules to reduce fuel use and GHGs from idling fleet vehicles and will be developed from knowledge of fleet vehicle requirements and driving behaviour. It would be developed by engaging fleet drivers and be integrated into a green driving program. A separate anti-idling policy can be developed for visitors to Town buildings.

Training. Green driving training could build on the idling reduction policy and integrate other green driving techniques including driving for fuel efficiency and route optimization. Engaging staff will help develop a culture of fuel efficiency and low-carbon mobility and will provide feedback from those with the greatest knowledge of driving and operating fleet vehicles.

5.5 Low-Carbon Fleet Replacement Options

Transitioning fleet vehicles immediately to electric vehicles will be constrained by available technology and cost. A review of the Town's planned fleet purchases and market scan indicates few opportunities for replacement with electric fleet vehicle options without significant cost, based on current prices. Options in the market for electric fleet vehicles are limited, often in early stages of development and carry a significant upfront cost. Initial maintenance may have to be outsourced until Town staff are trained in electric fleet maintenance.

As a result, the immediate focus should be on developing the electric vehicle infrastructure to prepare for staff and community personal vehicles, training for maintenance and potentially investing in an EV car to familiarize staff and public with electrically powered vehicles.

Stay connected to the market and other fleet managers. Although the current options may not be feasible immediately, low-carbon technology is developing quickly. Continuing to be well connected with other municipal fleet staff, which will ensure the Town can learn from others and keep on top of current technology.

Testing an electric vehicle. Purchasing an electric car for Town business would provide a number of benefits including reducing the greenhouse gas emissions of town business, demonstrating commitment

[8] As per Charge Up Ontario: A Guide for Businesses to invest in Electric Vehicle Charging Stations https://www.partnersinprojectgreen.com/wp-content/uploads/2017/01/PPG_Charge-Up-Ontario_EVSE-Report-UPDATED-MARCH_1_2017.pdf

to low-carbon mobility and help familiarizing staff and public with the technology. This will also allow fleet staff to become familiar with operating and maintaining an electric vehicle ahead of electric fleet vehicles being widely available. Current rebates for EVs from the Federal Government for up to $5000 for certain vehicles would lower the upfront cost of purchase. This cost is not included in the overall project budget costs.

Electric vehicle maintenance training. Current maintenance of vehicles is done by the Fleet, Fire and Halton Hills Hydro staff. They would require training for the maintenance and operation of EV fleet vehicles, although only when the vehicles they maintain are replaced by electric ones.

5.6 Low-Carbon Mobility Infrastructure

5.6.1 EV charging stations

Currently there are three locations with Town-owned EV charging stations. There are 7 dual charging stations (14 charging spots) at Mold-Masters SportsPlex, 1 dual charging station at Acton Arena, and two single charging stations at Halton Hills Hydro, although only one of those is available to the public outside of business hours (8am – 4pm Monday to Friday). Other privately-owned charging stations are available. There is no cost to the public to use these charging stations.

Currently the charging stations are used fairly frequently, as compared with similar installations[9], with 303 unique charges in 2018.

Table 8 Summary of EV charging stations and consumption

Site	Number of Charging Stations (Dual)	Average Consumption (kWh/month)	Operating Cost/ month
Mold-Masters SportsPlex	7	829.4	$124
Acton Arena	1	194.3	$29
Halton Hills Hydro	2	N/A	N/A

5.6.2 Expanding the infrastructure

It is recommended that the Town continue to expand the EV charging network to support the increase in electric vehicles. The next likely opportunity to install EV chargers would be Town Hall. The ducts for Level 2 chargers are already in place and a quote has already been obtained for installation and has been included in the costs for recommended measures. Level 2 chargers can take between 2-3 hours to provide a significant top up, depending on the vehicle.

Level 3 charging stations would not currently be recommended for Town Hall or any other municipal building. Also known as Direct Current Fast Chargers (or DCFC), these use a 480 volt system and can charge a vehicle to 80 per cent in about 30 minutes.[10] Although quick, the costs of Level 3 chargers are significantly higher than the Level 2: between $30,000 and $50,000 per single Level 3 charger, compared

[9] As per Charge up Ontario report, on average in 2016, workplace EV charging stations saw 167 charges per year and retail stations saw 190 charges per year.
[10] http://www.mto.gov.on.ca/english/vehicles/electric/charging-electric-vehicle.shtml

with $2,500 to $4,000 per Level 2 charger.[11] Installation costs vary with building configurations and potential additional transformer costs needed to handle the increased electrical load.

In the future, Town EV charging station installations could consider financing from advertising, as is already done in California and elsewhere. This would entail renting the charging locations for advertising space, potentially adding revenue. An alternative would be charging for service, where users would pay for the electricity, or "charging-as-a-service" where the chargers are leased rather than owned and would also entail drivers paying for use.

5.6.3 Additional EV charging station locations

When undertaking a major renovation of a facility or new construction, installing EV charging stations should be part of Low-Carbon Design Brief. This would include the consideration in the major renovation of the Gellert Community Centre.

5.7 Low-Carbon Mobility Measure Implementation Costs

Table 9 Low-carbon mobility measure implementation costs

	2019	2020	2021	2022	2023	2024	2025+	Total
EV charging station Town Hall		$27,000						$27,000
EV Maintenance Training [12]				$6,500				$6,500
EV Town vehicle[13]				$37,500				$37,500
TOTAL		**$27,000**		**$44,000**				**$71,000**

5.8 Employee Commuting

As the Town of Halton Hills has no direct control over employee commuting patterns and emissions, the following will help reduce staff commuting and increase take up of lower carbon modes of commuting. These are no cost/low cost or build on other low-carbon strategies, so no additional costs are anticipated.

According to the Town of Halton Hills 2018 Inventory, employee commuting makes up 19% of the overall municipal emissions.[14] Employees primarily drive to work, as can be seen below.

Table 10 Town of Halton Hills employee commuting (2017)

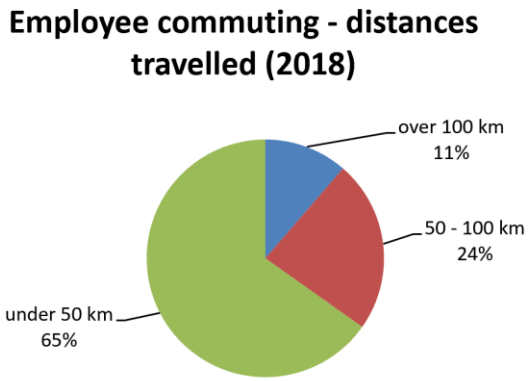
Employee means of commuting (2017)	Percent	Number of employees
Drive	88%	240

[11] Charge Up Ontario
[12] Based on Electric Vehicle Operations and Maintenance Technician training http://www.trainingforsolar.com/EV_Technician.html
[13] https://www.autotrader.ca/newsfeatures/20190405/every-electric-vehicle-and-plug-in-hybrid-available-in-canada-in-april-2019/
[14] Employee commuting figures not tracked but based on assumptions of distances travelled from employee home locations as per 2018 Inventory.

Employee means of commuting (2017)	Percent	Number of employees
Walk	2%	5
Bike	2%	5
Passenger	8%	22
TOTAL	**100%**	**272**

About 34.8% of the employees travel 50 km or more to get to work but make up 72.3% of the distance travelled and the emissions created (463 tonnes CO2e).

Figure 5 Distances travelled by Town employees



5.8.1 Low-Carbon Commuting Recommendations

Although over half the Town employees have a short commuting distance, focus should be on reducing commuting for employees travelling over 50 km, who make up the larger part of the GHG emissions. Strategies include:

- Continue to promote Smart Commute and other ride sharing as well as other alternative modes of transportation.
- Establish a telecommuting policy so employees can work from home and hold meetings by conference call. This will reduce employee travel time and have the additional benefit of providing more space flexibility at Town Hall, which was built to hold approximately 100 staff and now has about 200.
- Provide incentives for employees to consider plug-in electric vehicle or hybrid vehicle options, provide information about electric vehicle rebate programs and provide the infrastructure for employees to charge electric vehicles at work. Once these initiatives are tested with Town staff, they could be extended to the wider Town community.
- Purchase a plug-in electric vehicle that can be used by employees so they become familiar with electric vehicles. Experience at Halton Hills Hydro from their purchase of a plug-in EV, as well as

other studies[15], shows people are more comfortable buying an EV once they know how they operate one and where charging stations are located.

5.9 Performance Indicators

The Town is already tracking its energy and environmental performance and reports on progress internally and externally. These additional performance indicators are easily managed and measured metrics that will be effective over the long term.

a. Number of EV charging stations
b. Share of fleet that is electric (# of electrically powered vehicles)
c. Employee commuting reduction (GHGs and %)

[15] Unplugged: Myths block road to the electric car dream (BC Hydro), pg. 6 https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/news-and-features/Report-unplugged-myths-block-road-to-EV-dream_April%202018.pdf

6 LOW-CARBON FINANCIAL STRATEGY

There are three components of the strategy for meeting the Town's carbon reduction goals and financing the investments which will be required in facilities and fleet. The goal of the Low-Carbon Financial Strategy is to establish funding mechanisms for implementation of the energy efficiency, renewable energy and low-carbon mobility strategies. The strategy should be coordinated with the Town's long-range financial planning so that it is a priority.

6.1 Funding Energy Efficiency Projects

First, energy efficiency projects provide good returns on investment in the up-front costs of retrofits to building systems which are offset by utility company incentives and repaid over time through utility cost savings. These projects have been funded to date through an annual budget administered by the Office of Sustainability and reviewed and managed by the Corporate Energy Team. A model to illustrate the return on investment, based on the energy efficiency measures planned within the scope of the Portfolio Energy Optimization Strategy presented in the Plan, is presented in Section 3.5.2 Cash Flow and Internal Rate of Return. It illustrates how this can work to achieve the projected savings.

The Town's approach to funding the low-carbon strategies should focus on achieving early wins and substantial utility cost and emissions savings. Buildings that have the greatest potential for energy savings should be prioritized along with projects with a high return on investment. Operational improvements can provide early wins as they are generally low/no cost and can generate significant savings. Maximizing any future federal or other greenhouse gas reduction funding program opportunities will require that "shovel-ready" projects are planned and ready to go.

6.2 Long-Term Capital Planning

The second part of the strategy involves ensuring all capital projects are planned, budgeted, designed and implemented to maximize emissions reductions, as an integral part of the long-term decisions being made. Integrating this approach into the Needs Assessment of the Corporate Asset Management Program will be an essential step to ensure long-term success. This requires changes to the project development process to incorporate an integrated design process and allow time for consideration and analysis of least-carbon alternatives to like-for-like replacements and conventional designs. Through an integrated design process all stakeholders, including operations and the Office of Sustainability, would be included at the initial design stage to ensure lifecycle costing, ongoing operations, sustainability and low-carbon considerations are incorporated in the design. This design should be informed by high-performance energy and water targets, power density and service level metrics to ensure buildings are designed to perform as expected. Additional funding will also generally be required for new system concepts, building upgrades, heat recovery and renewable energy which are needed to meet the Town's goals and most cost-effective when included as part of these capital projects. Allowances should be included in the Town's long-term capital plans to account for these requirements.

6.3 Financing Low-Carbon Mobility and Renewables

The third strategy component considered necessary to meet the Town's 2030 goal is strategic investment in electric vehicles and infrastructure, and in standalone geothermal and renewable energy projects, funded wherever possible by climate-related grants from higher levels of government. Preparation of a renewable energy plan is recommended to identify the best technologies and

applications for the Town's existing fleet and buildings and develop schematic designs, capital budgets and business cases so that prompt applications can be prepared as funding becomes available.

6.4 Funding Sources

Since the Town prefers to implement the low-carbon strategies without taking on debt or adding to taxes, potential sources of funding are:

1. **Increase the annual budget allocation.** This would follow the same process to the one already in place with core funding coming from the Town's budget. Additional funding may require deferral of other projects. Utility cost savings and/or grants and incentives will be considered as part of project viability review but, when received, would go back into general revenue.
2. **Establish a Green Revolving Fund (GRF).** Green Revolving Funds are financial mechanisms that recycle the utility cost savings, incentives and/or grants received, and other associated cost savings and revenues, to finance future energy efficiency projects. They are increasingly used by municipalities to create a transparent and accountable source of funding. Variations on GRFs abound, with some putting 100% of utility and other cost avoidance back into the fund while others put back smaller percentage or solely grants and incentives. Initial seed funding is required to get the GRF rolling.

The Town should establish a Green Revolving Fund (GRF) as a means of establishing a predictable and accountable financing source for implementation of the Plan. The GRF also has benefits of positive public perception while driving the early realization of the greatest utility cost savings, alternative funding sources and rigorous monitoring of ongoing performance and savings. The GRF will require dedicated staff time to manage the accounting, communicate results and also actively search and apply for additional sources of funding such grants and incentives. The GRF should scale up over time, allowing staff to develop management and monitoring processes and become familiar with the opportunities and challenges. Further details on establishing a Green Revolving Fund are provided in Appendix G: Low-Carbon Financial Strategy – Green Revolving Fund.

6.5 Performance Indicators

The Town is already tracking its energy and environmental performance and reports on progress internally and externally. These additional performance indicators are strategically chosen as the most relevant, easily managed and measured metrics that will be effective over the long term.

a. Incentives – applied for, received ($ or # of applications)
b. Outside funding (such as FCM) – applied for, received ($ or # of applications)
c. Share of energy efficiency project costs funded through Green Revolving Fund vs from capital budget

7 MANAGEMENT AND ORGANIZATIONAL ALIGNMENT

The transition to a low-carbon future affects every aspect of society – how we live, what we buy, how we move around, the decisions we make every day. For the Town of Halton Hills, this transition will build on a well-established foundation of effective management and a deep commitment to sustainability. In addition to rethinking how buildings work, integrating new technology, and changing the purchasing criteria for vehicles, equipment and products, a successful transition will require additional alignment of management systems and processes and organizational capacity-building.

Actions recommended in this section, along with actions identified in other sections, are summarized in Appendix D: Recommended Organizational Actions.

7.1 Corporate Asset Management Program

The Town's sector-leading Corporate Asset Management program provides the management platform for ensuring that Town assets meet the minimum low-carbon requirements throughout their lifecycle, from planning and acquisition through operations and maintenance to end-of-life decommissioning and disposal. As outlined in Section 6 Low-Carbon Financial Strategy, the Needs Assessment project review will also include fuel efficiency, furthering low-carbon readiness and meeting low-carbon goals. The lifecycle assessment approach already integrated in the program is a pivotal component of success of low-carbon strategies.

7.2 Corporate Sustainable Building Policy and Green Development Standard

The Town's Corporate Sustainable Building Policy provides guidance on new municipal building design and construction. It should incorporate target efficiencies and low-carbon energy and mobility considerations including heat recovery, geothermal, renewable energy generation (solar readiness at minimum), and EV parking and charging station requirements.

Low-carbon considerations should also be incorporated in the Green Development Standard, which guides the construction of all buildings within the Town of Halton Hills. Currently the Green Development Standard does not contain mandatory elements, however, high energy efficiency, low-carbon and renewable energy generation should be prioritized or mandatory to support the Town's zero carbon goal.

As the Green Development Standard is to be updated in 2019, it would be efficient to have it also apply to public and municipal new building design. Municipal buildings could be subject to mandatory requirements, particularly in relation to lifecycle costs, high efficiency and low-carbon energy and mobility considerations.

7.3 New Construction and Capital Improvements

As outlined in Section 6 Low-Carbon Financial Strategy, an integrated design process is a collaborative process bringing together designers, architects, engineers, building managers, operators and users to ensure all design, construction, operation and use considerations over the lifetime of the building are taken into account. Implementing this process will help ensure that highly efficient, low-carbon buildings are built and that they are operated at a high level of performance. Beginning this process early will define the requirements for the Low-Carbon Design Brief that guides the desired end point.

7.4 Performance Monitoring and Reporting

The Town is already using energy data to report on energy performance and meet regularly through Corporate Energy Team meetings to review performance. This reporting, together with additional data that is recommended to be collected, will inform progress towards low-carbon goals. A review of reporting should be included in the Corporate Energy Team meetings to ensure continuous improvement.

Additional data recommended for collection includes:

- Building automation system data – installing building automation systems will not only allow for more precise control of buildings systems but also provide data to ensure building systems only function when required
- Lifecycle costing data in a Work Management System to track and analyze operations and maintenance costs and compare with energy efficiency data
- Automatic vehicle tracking system or automatic vehicle location (AVL) system data - as recommended in the Corporate Fleet Management Strategy, this system will provide data on how fleet vehicles are being used and will identify how routes can be optimized and inform idling reduction policies for fleet vehicles
- Electric vehicle (EV) charger use data – Halton Hills Hydro monitors current installed charger use by tracking the number of chargers and electricity used. As additional EV chargers are installed, ideally Halton Hills Hydro would continue to monitor and report on their use. This information is critical for monitoring growth of EV use and reductions in employee and fleet carbon emissions
- Performance indicators – this Corporate Energy Plan identifies performance metrics beyond energy savings, which are key indicators of progress toward targets and goals. They should be measured and monitored, and reporting of progress on these metrics should be integrated into regular reporting to stakeholders

7.5 Staff Training and Support

Enhancing staff capability in energy management and building automation will be achieved by defining job-specific expectations, providing on-the-job training opportunities and working with service providers to provide necessary training and support. Specific training recommendations are:

- Energy performance management principles including how much energy equipment uses and making the connections between targeted and actual savings and actions taken
- Use of Building Automation Systems to monitor operations and improve performance
- Impact of operations and maintenance on energy efficiency in different building types
- Building operator training on operation of installed geothermal systems once the investigation is complete, operation has been documented and performance has been optimized
- Training on maintenance and operation of electric vehicles for fleet operations when purchase of electric fleet vehicles becomes possible
- Low-carbon and building equipment-specific training when such systems are installed

- Further green driving training once the AVL system provides feedback on fleet driving performance

7.6 Procurement

Energy and emissions performance is substantially dependent on the products and services of external providers, and some modified procurement practices will help to obtain high-performance outcomes. Some new processes are recommended which rely on continuity and consistency, including major system testing and additional building automation. These require architects, engineers and contractors who are experienced in and have proven track records with the low-carbon design methods, systems and equipment required to meet the goals. To meet these requirements while maintaining the Town's commitment to transparency, accountability and openness, assessment and further development of the following would be required:

- Evaluation criteria for professional services to ensure low-carbon design qualifications
- Standing Offer agreements with contractors including testing and balancing, heating, cooling and ventilation, and building automation system service and supply
- Outcomes-based heating, cooling and ventilation and building automation system service contracts

7.7 Occupant Engagement

Staff and visitors play a significant role in the energy performance of Town facilities and the Town's overall environmental footprint. The Town has an opportunity to clearly communicate their goals, why they are important to all parties and how everyone can play their part in meeting them. Specifically:

- Once comfort issues have been addressed through building optimization, create and enforce a policy relating to temperature setpoints, operating schedules and use of personal appliances
- Encourage and support walking, cycling, electric vehicles and ride-sharing

7.8 Organizational Capacity and Resourcing

Additional resources will be needed for the Office of Sustainability to meet the goals and implement the strategies outlined in the Plan, particularly relating to:

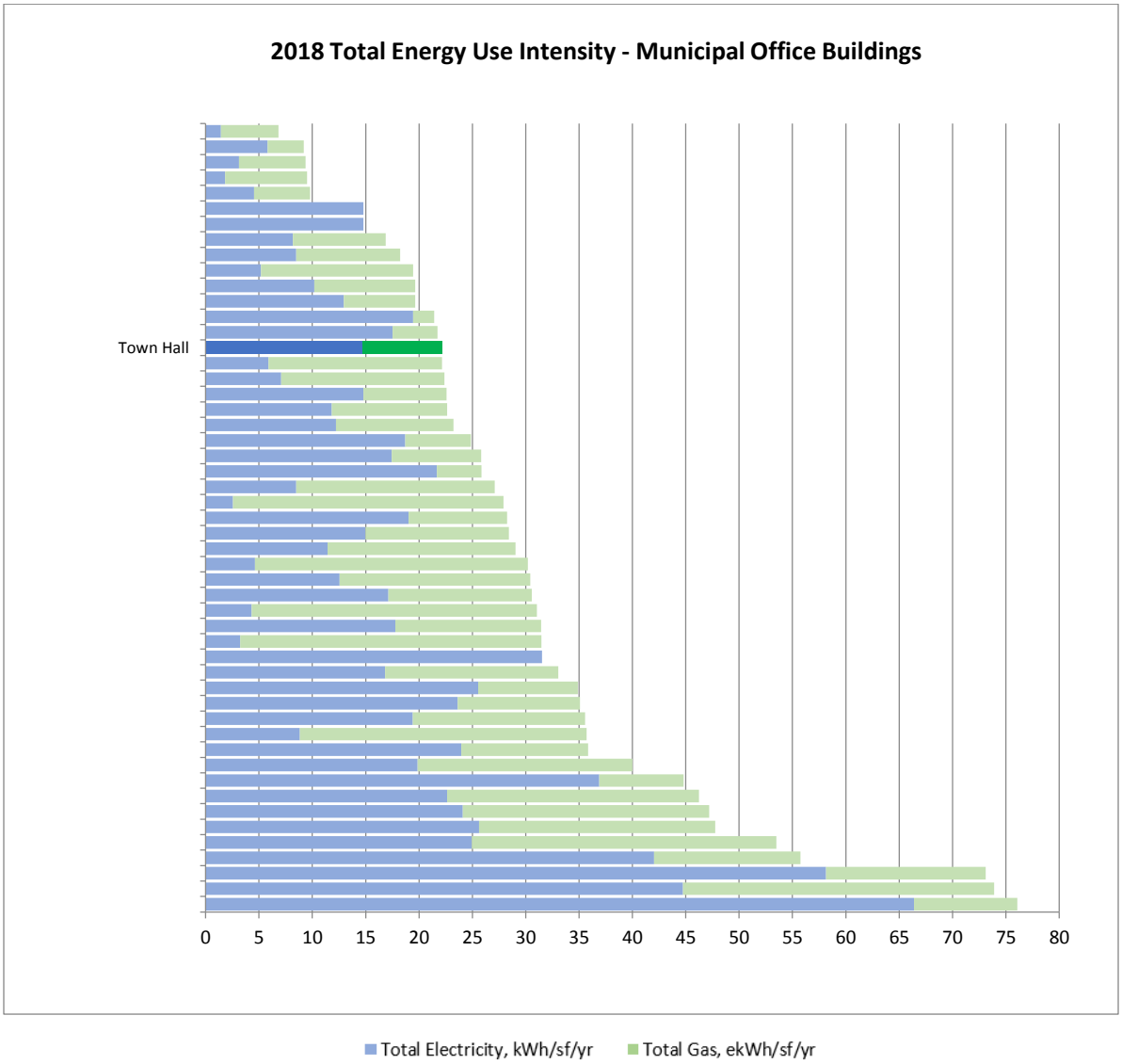
- Creating annual goals and work plans
- Developing approach and policy for evaluating and implementation of all sustainability measures
- Identifying and managing the implementation of energy efficiency and low-carbon projects, including required measurement and verification processes and obtaining utility company incentives
- Identifying and applying for federal, provincial and other funding sources
- Managing staff training programs
- Championing energy efficiency and low-carbon options with other stakeholders through capital planning, project development, procurement and other management processes

- Monitoring and reporting on progress
- Internal and external communications

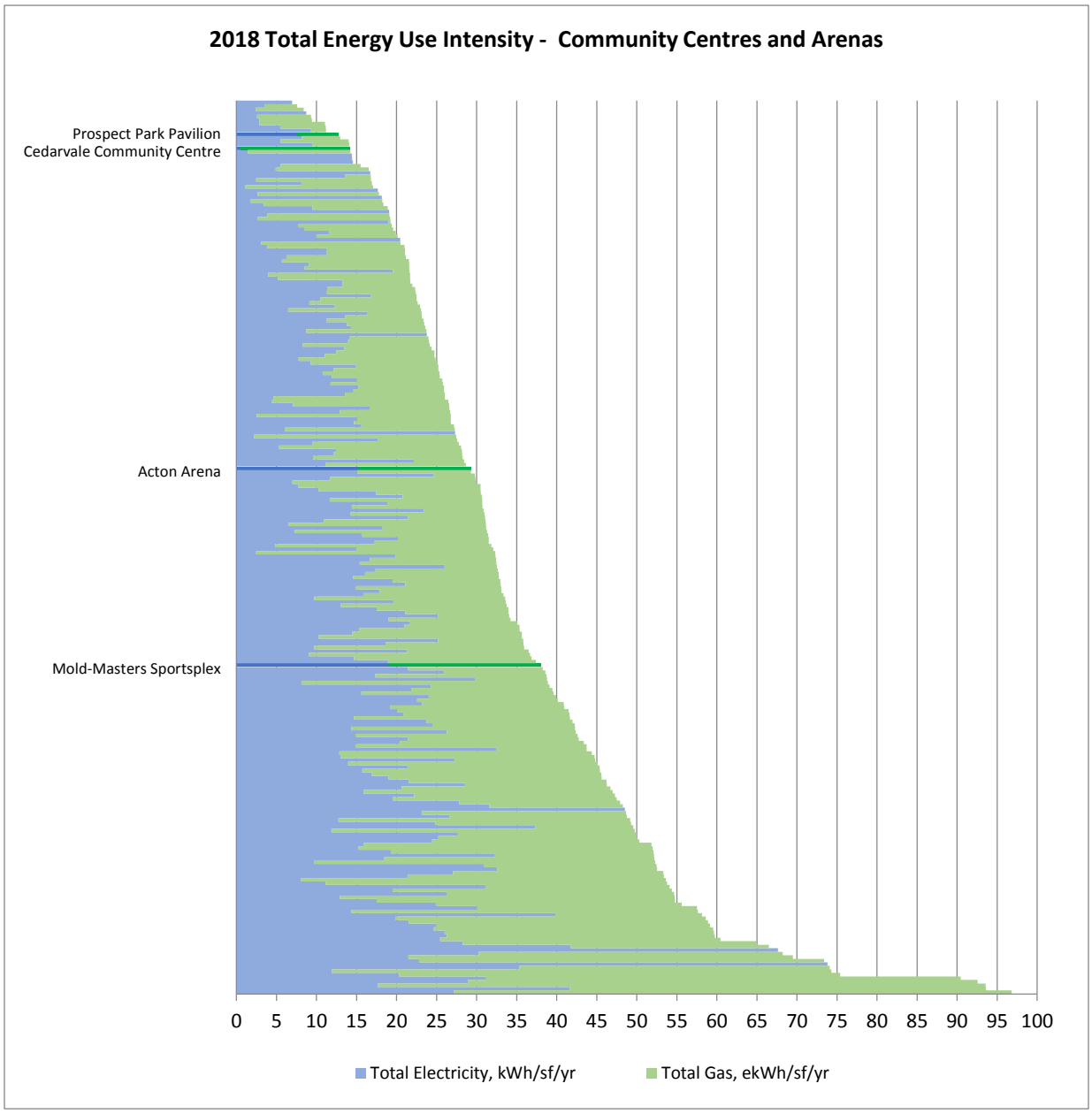
8 APPENDIX A: COMPARISON WITH OTHER FACILITIES

This appendix provides a comparison of total energy use intensity of Town facilities with other facilities of similar types. 2018 energy benchmarking results are weather-normalized and compared with other town and city halls from the Mayors' Megawatt Challenge database.

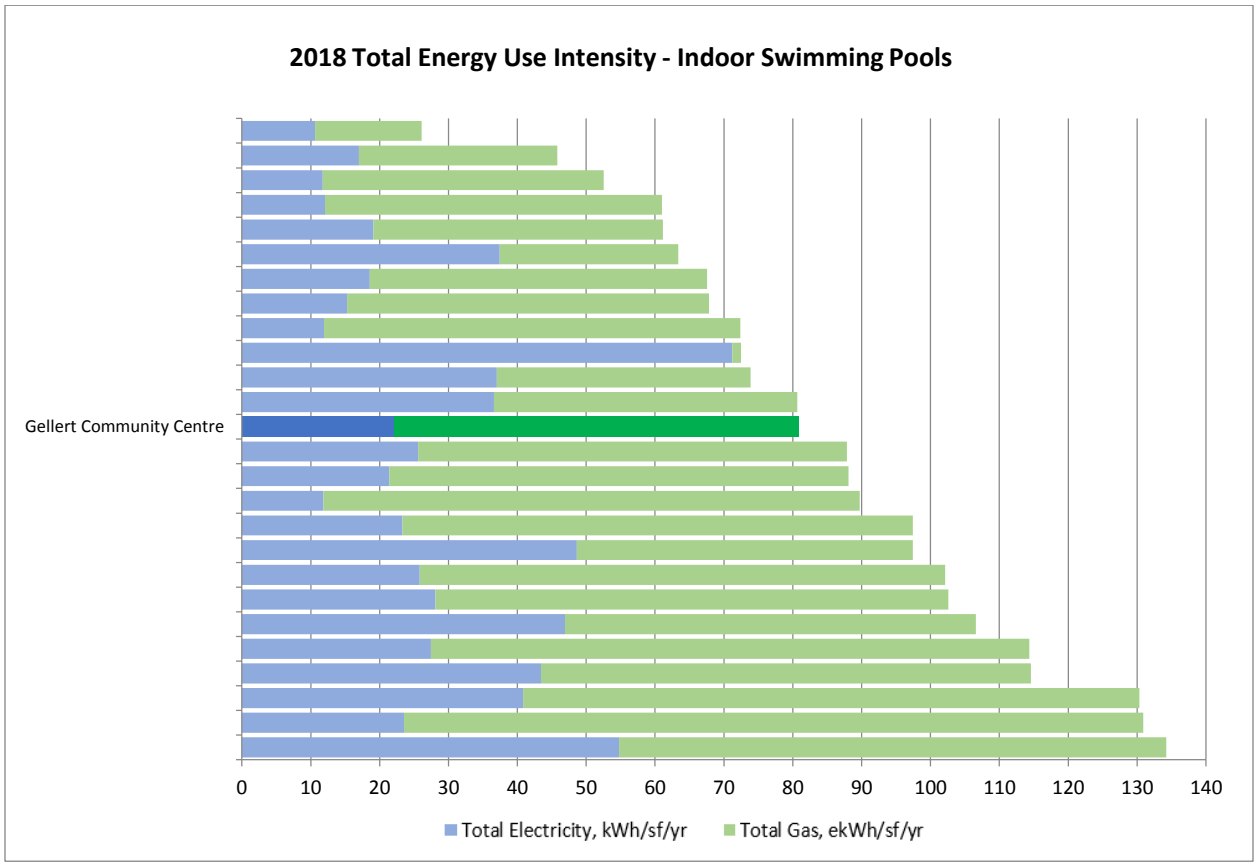
Facility	Electricity Intensity (kWh/sf)	Thermal Energy Intensity (ekWh/sf)	Total Energy Intensity (ekWh/sf)
Town Hall	14.7	7.4	22.2



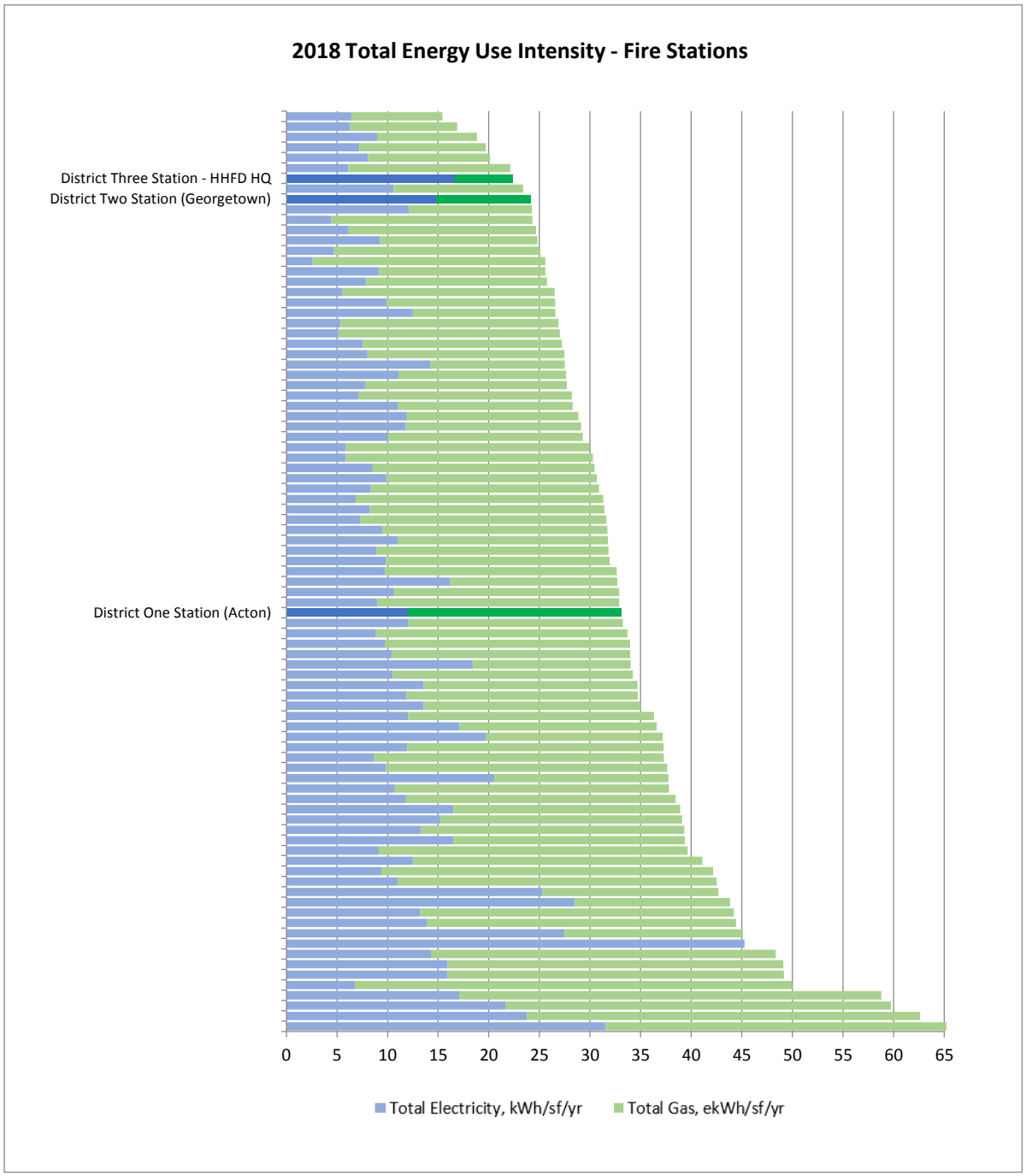
Facility	Electricity Intensity (kWh/sf)	Thermal Energy Intensity (ekWh/sf)	Total Energy Intensity (ekWh/sf)
Prospect Park Pavilion	7.4	5.3	12.7
Cedarvale Community Centre	1.4	12.8	14.2
Acton Arena	15.1	14.2	29.3
Mold-Masters SportsPlex	21.4	16.8	38.2



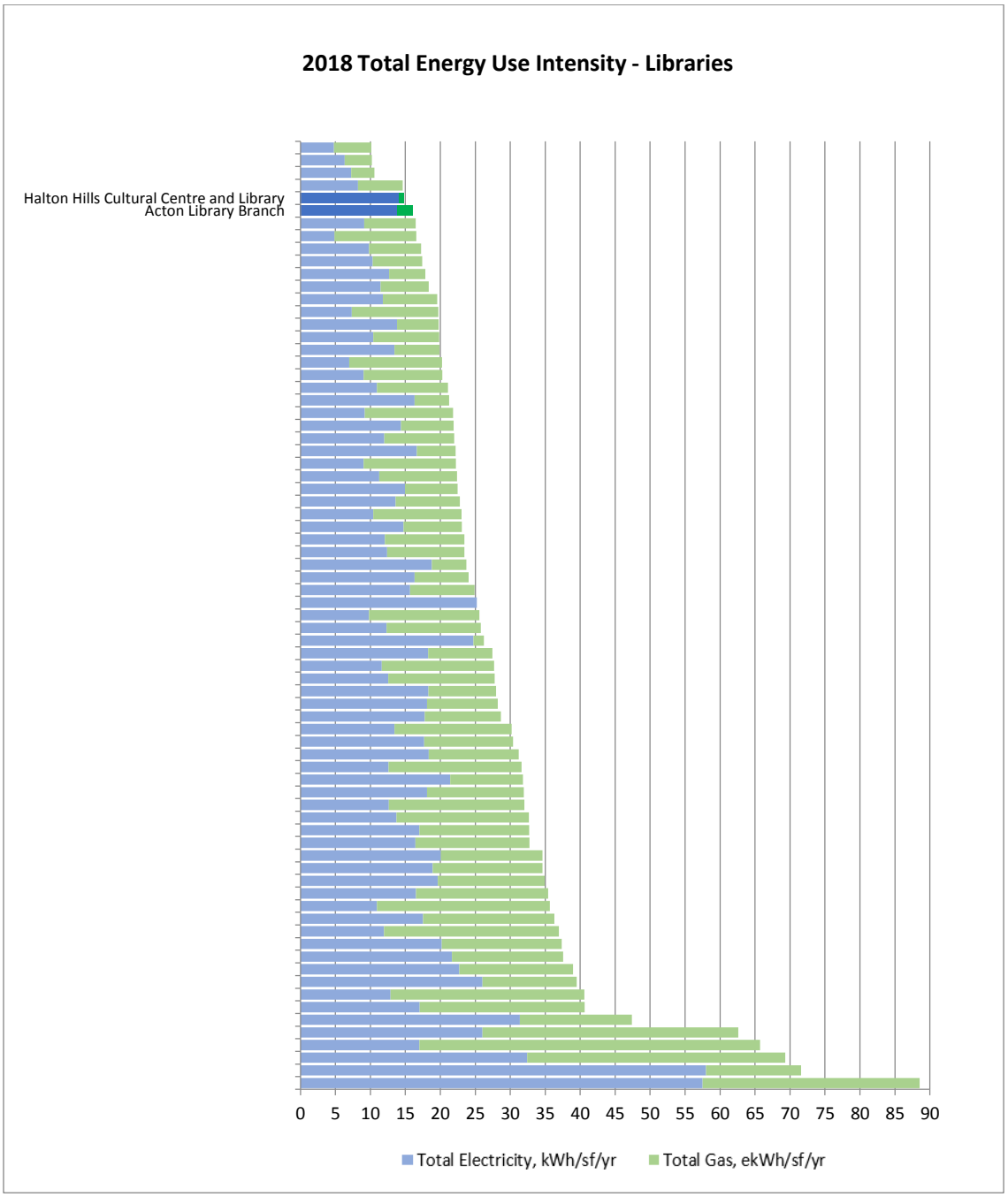
Facility	Electricity Intensity (kWh/sf)	Thermal Energy Intensity (ekWh/sf)	Total Energy Intensity (ekWh/sf)
Gellert Community Centre	22.1	58.7	80.8



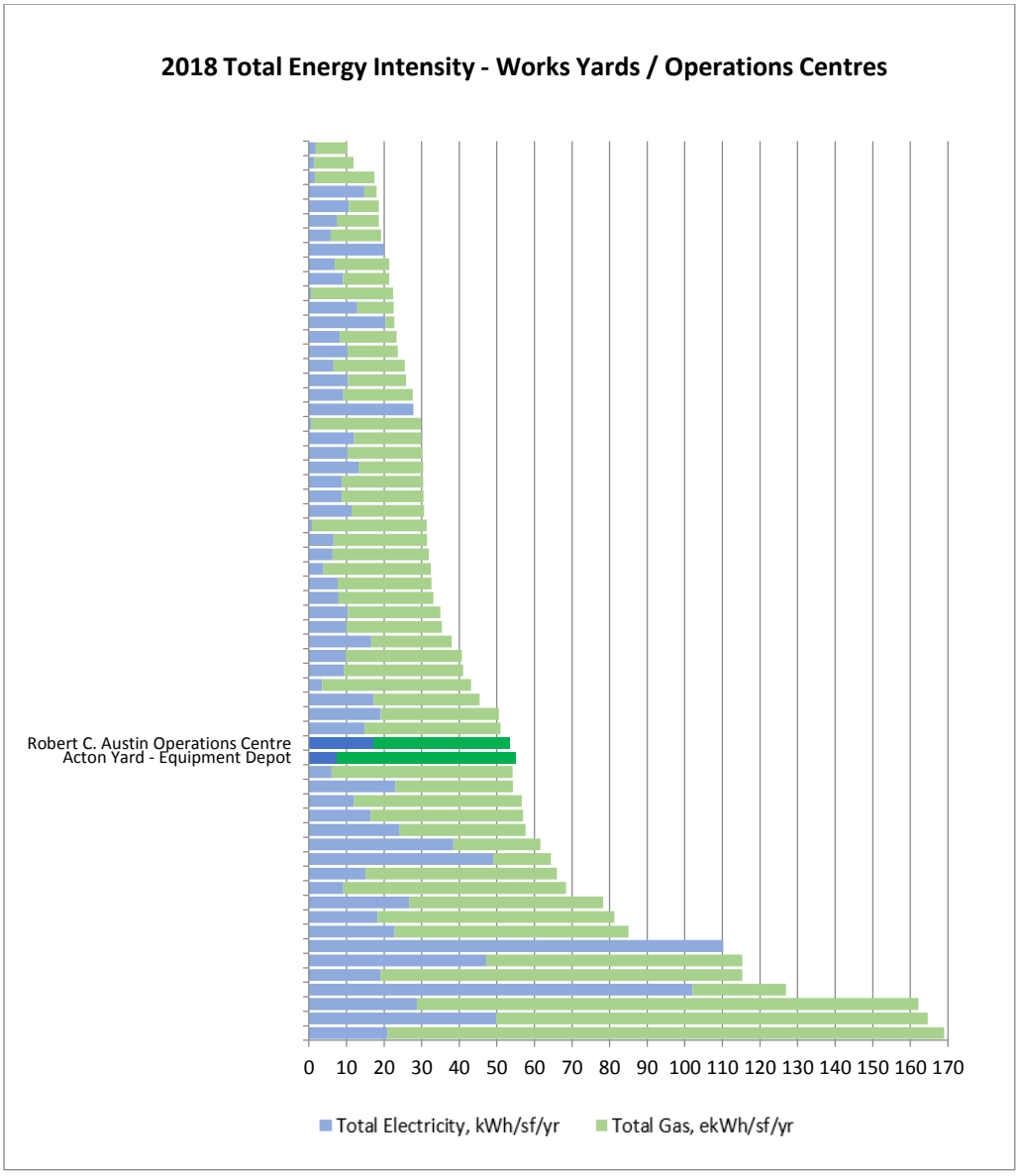
Facility	Electricity Intensity (kWh/sf)	Thermal Energy Intensity (ekWh/sf)	Total Energy Intensity (ekWh/sf)
District Three Station - HHFD HQ	16.7	5.7	22.4
District Two Station (Georgetown)	14.8	9.4	24.2
District One Station (Acton)	12.0	21.0	33.0



Facility	Electricity Intensity (kWh/sf)	Thermal Energy Intensity (ekWh/sf)	Total Energy Intensity (ekWh/sf)
Acton Library Branch	13.8	2.2	16.0
Halton Hills Cultural Centre and Library	14.2	0.7	14.8



Facility	Electricity Intensity (kWh/sf)	Thermal Energy Intensity (ekWh/sf)	Total Energy Intensity (ekWh/sf)
Acton Yard – Equipment Depot	7.3	47.7	**55.0**
Robert C Austin Operations Centre	17.1	36.1	**53.2**



9 APPENDIX B: DETAILS OF ENERGY EFFICIENCY MEASURES

9.1 Mold-Masters SportsPlex

Table 11 Mold-Masters SportsPlex – existing condition and description of recommended measures

System	Existing Condition	Recommended Measures
Lighting	Lighting in the facility consists of T5, T8 lighting and LED lighting. 80% of the building has T5 & T8 lighting and the remaining 20% has been recently converted to LED lighting. The new expansion lights are being fed through emergency lighting circuit causing the lights to remain ON all the time.	Conduct lighting audit to ensure correct light levels and power densities. Convert all lighting to LED. Retrofit lighting circuits to maximize scheduling. Install photo- and occupancy-controls in accordance with Town standard.
HVAC	Air conditioning is provided to the roughly 40% of the building. Two gas-fired dehumidifiers service the ice rinks. The 17 rooftop units (RTUs) have DX coils and are gas fired to provide fresh air and heating to the common areas, change rooms, and office spaces. Typical size of the RTUs is SF - 7.5 HP and RF - 3 HP. The rooftop units use local thermostats for temperature control. The space conditioning needs are non-uniform with specific air changes for the ice rinks and change rooms/washrooms. Heat recovery from the ice plant is used to preheat DHW. Heating pumps have VFDs. The Alcott rink units are approaching end of life and are due for replacement.	Test air handling units, dehumidifiers, and pumps to determine actual flows and pressures, rebalance, retrofit and refurbish accordingly. Monitor HVAC unit, dehumidifier and heat recovery operation and make necessary control changes. Install VFDs on selected units. Consider alternative heating sources when replacing units. BAS installation for HVAC equipment & web/central control for ice plant controls.
Ice Plant	The ice plant is served by an ammonia-based fluid cooler and runs for 9 months/year. The facility underwent an expansion adding 2 ice rinks which are more efficient than the old rinks. The brine header is uninsulated and the resurfacing water temperature is 140°F. The current operation of the brine pumps is duty/standby.	Test brine pumps and make any indicated changes. Monitor ice plant operation and controls and make necessary changes. Lower resurfacing water temperature to 110°F. Insulate the brine header.

Table 12 Mold-Masters SportsPlex – recommended measure cost and savings summary

System	Recommended Measures	Estimated Savings ($/yr)	Estimated Cost ($)	Electricity Savings (kWh/yr)	Gas Savings (m3/yr)
Lighting	Lighting audit, lighting retrofit, controls	$28,886	$190,260	169,917	
HVAC & Controls Retrofit	Performance testing		$24,000		
	Ventilation refurbishment	$19,673	$48,068	91,755	15,776
	BAS installation & ice plant controls integration with BAS	$24,045	$362,000	112,145	19,282
	VFD installation and reprogramming local controllers	$60,113	$205,700	280,363	48,206
Operations	Ice plant controls optimization	$38,588	$36,995	169,917	37,563
Building Envelope	Thermographic scan of building exteriors & minor repairs	$5,465	$30,200	25,488	4,382
TOTAL		**$176,771**	**$897,223**	**849,585**	**125,209**

9.2 Acton Arena

Table 13 Acton Arena – existing condition and description of recommended measures

System	Existing Condition	Recommended Measures
Lighting	The ice rinks are illuminated by LEDs. The lighting system for the overall facility consists of LEDs (50%), T5 and T8 lighting. The T8 and T5 lighting is in the process of being replaced by LED.	Conduct lighting audit to ensure correct light levels and power densities. Convert remaining fluorescent lighting to LED. Retrofit lighting circuits to maximize scheduling. Install photo- and occupancy-controls in accordance with Town standard.
HVAC	Ventilation is provided by air handling units located in mechanical room and rooftop. The HVAC systems are in relatively good shape. The scheduling of the equipment and the SOP need to be reviewed to optimize performance. The thermostats are relatively old (5-10 years) and do not provide any feedback to the equipment. Heat recovery from the ice plant is used to preheat DHW. Primary Heating pumps have been retrofitted with VFDs and set to run at a fixed pre-set speed but were switched off during the site visit. In the old arena the space temperature is maintained by residual heat from the arena dehumidifier, pre-heat from the makeup air unit, and occasionally by the gas-fired radiant -heaters (these are rarely turned on, and only when requested by spectators). The rooftop units are too small for VFD consideration.	Test air handling units, dehumidifiers and pumps to determine actual flows and pressures, rebalance, retrofit and refurbish accordingly. Monitor HVAC unit, dehumidifier and heat recovery operation and make necessary control changes. BAS installation for HVAC equipment & web/central control for ice plant controls.
Ice Plant	The ice plant is served by an ammonia-based fluid cooler and runs for 6 months/year. The facility underwent an expansion adding 2 ice rinks which are more efficient than the old rinks. The brine header is uninsulated and the resurfacing water temperature is 140°F. The current operation of the brine pumps is duty/standby.	Test brine pumps and make any indicated changes. Monitor ice plant operation and controls and make necessary changes. Lower resurfacing water temperature to 110°F. Insulate the brine header.

Table 14 Acton Arena – recommended measure cost and savings summary

System	Recommended Measures	Estimated Savings ($/yr)	Estimated Cost ($)	Electricity Savings (kWh/yr)	Gas Savings (m3/yr)
Lighting	Lighting audit, lighting retrofit, controls	$1,796	$60,720	10,566	
HVAC & Controls Retrofit	Performance testing		$14,000		
	Ventilation refurbishment	$6,353	$22,080	14,793	14,858
	BAS installation & ice plant controls integration with BAS	$8,735	$232,000	20,340	20,430
Operations	Ice plant controls optimization	$5,010	$23,767	5,283	15,920
Building Envelope	Thermographic scan of building exteriors & minor repairs	$794	$18,400	1,849	1,857
TOTAL		**$22,688**	**$370,967**	**52,832**	**53,066**

9.3 Gellert Community Centre

Table 15 Gellert Community Centre - existing condition and description of recommended measures

System	Existing Condition	Recommended Measures
HVAC	Water hardness is an issue - often the tempered water clogs the heat exchanger. In 2011, VFDs have been installed on the main circulation pumps. There are 3 pools with varying temperatures. The Dectron unit runs at full speed 24/7 and is not functioning properly with a very low delta across inlet and outlet temperature. No air balancing has been done since the equipment was handed over. The 4 boilers (1 for DHW with the rest serving the pool) have no stages or modulation and work in lead lag sequence. The DHW mixing valve malfunctions leading to "too cold" complaints. Caulking is being carried out on a periodic basis to arrest infiltration and leakage around windows. No mould problems have been noted. The Kinsman Hall has an opportunity to have destratification fans to reduce heat loads during unoccupied periods. The Rooftop units that serve the common spaces such as offices and lobby are small and controlled by a Trane supervisory controller with occupied and unoccupied setpoints and scheduling.	Test boilers and monitor operation to determine whether burner and/or control upgrades required. Test air handling units, Dectron unit and pumps to determine actual flows and pressures, rebalance, retrofit and refurbish accordingly. Monitor HVAC unit, Dectron and heat recovery operation and make necessary control changes. Repair mixing valve and optimize DHW supply temperatures. Install destratification fans in Kinsman Hall. Upgrade Trane Supervisory Control for 7 rooftop units and install BAS that will include all the equipment
Pools	There are 3 pools, each operating at a different temperature. The circulation pumps have VFDs and operate at pre-set constant speed duty/standby.	Add controls to allow pool water temperature reset. Test pumps and modify control to vary speed in accordance with Code requirements. Evaluate liquid pool covers.

Table 16 Gellert Community Centre – recommended measure cost and savings summary

System	Recommended Measures	Estimated Savings ($/yr)	Estimated Cost ($)	Electricity Savings (kWh/yr)	Gas Savings (m3/yr)
HVAC & Controls Retrofit	Performance testing		$16,000		
	Installation of destratification fans	$2,969	$18,000		11,496
	BAS installation, pool controls integration with BAS	$11,135	$226,000		43,109
Operations	Pool operation	$12,661	$49,717		49,016
Building Envelope	Thermographic scan of building exteriors and minor repairs	$742	$7,600		2,874
TOTAL		**$27,508**	**$317,317**		**106,495**

9.4 District Three Station – HHFD HQ

Table 17 District Three Station – HHFD HQ – existing condition and description of recommended measures

System	Existing Condition	Recommended Measures
Lighting	The lighting system consists of mostly LED lights with a few areas still using T8 lamps. Most spaces are overlit.	Conduct lighting audit and modify fixtures to ensure correct light levels and power densities. Convert all lighting to LED. Retrofit lighting circuits to maximize scheduling. Install photo- and occupancy-controls in accordance with Town standard.
HVAC	Cooling is provided by 4 split units (2 located on ground level and 2 located on the roof) and two ground-source heat pumps. The bay area is heated by a make up air unit and gas fired radiant tube heaters. The BAS controls the two heat pumps and monitors the geothermal loop. The geothermal system experiences substantial operational and maintenance problems. No commissioning was done and no documentation is available. DHW is supplied by a gas-fired water heater for washrooms and bay area. The bay area doors are controlled and close immediately after the vehicle leaves the bay.	Test air handling units, heat pumps and pumps to determine actual flows and pressures, rebalance, retrofit and refurbish accordingly. Monitor heat pump loop and HVAC unit operation and make necessary control changes. Analyze and resolve geothermal system operation and prepare documentation. Recommissioning of the existing BAS and installation of additional sensors.

Table 18 District Three Station – HHFD HQ – recommended measure cost and savings summary

System	Recommended Measures	Estimated Savings ($/yr)	Estimated Cost ($)	Electricity Savings (kWh/yr)	Gas Savings (m3/yr)
Lighting	Lighting audit, lighting retrofit, controls	$3,446	$9,804	20,270	
HVAC & Controls Retrofit/Geothermal Optimization	Geothermal investigation and performance testing		$25,000		
	Ventilation refurbishment	$10,946	$12,901	57,647	4,438
	BAS upgrades	$1,723	$6,672	10,135	
	HVAC optimization	$5,476	$5,476	30,276	1,274
Building Envelope	Thermographic scan of building exteriors & minor repairs	$579	$2,723	3,034	234
TOTAL		**$22,167**	**$67,516**	**121,362**	**5,945**

9.5 Town Hall

Table 19 Town Hall – existing condition and description of recommended measures

System	Existing Condition	Recommended Measures
HVAC	There are 56 heat pumps fed by a glycol loop, with occupied/unoccupied fan control. Auxiliary heating is done by 2 boilers which were recently replaced. A 2-speed cooling tower is to be replaced in 2019. The hydronic pumps have been retrofitted with VFDs but are running at full speed. The heat pumps are at end of life and are due for replacement. Supplemental perimeter heating is provided by electrical baseboard heaters controlled by a timer 7 am to 4 pm. MUA unit has a 5 hp motor with no cooling and a gas-fired burner, supplying 6,000 cfm of fresh air into the ducting of the heat pumps. Humidifier is electric, controlled by humidistat with setpoint at 34%-40%. Exit vestibule heating is working on thermostat and was recently replaced. 6 heat pumps have been replaced with Ecobee controllers. The cafeteria area has a high bay area with east-facing windows which are subject to solar gain and heat losses and occupant complaints.	Test MUA unit and pumps to determine actual flows and pressures, rebalance, retrofit and refurbish accordingly. Monitor MUA unit, humidifier and heat recovery operation and make necessary control changes. Optimize operating schedules. Test boilers and cooling tower and retrofit/refurbish as necessary. Install destratification fans in the cafeteria. Install VFD on the MUA unit with CO2 control. Additional sensors to be installed; BAS installation.

Table 20 Town Hall – recommended measure cost and savings summary

System	Recommended Measures	Estimated Savings ($/yr)	Estimated Cost ($)	Electricity Savings (kWh/yr)	Gas Savings (m3/yr)
HVAC & Controls Retrofit	Performance testing		$15,350		
	Ventilation refurbishment	$10,553	$10,333	57,658	2,907
	VFD installation and reprogramming local controllers	$7,538	$4,933	41,185	2,076
	Installation of destratification fans	$1,508	$21,000	8,237	415
	BAS installation	$9,045	$212,000	49,421	2,492
	HVAC optimization	$2,663	$7,933	12,509	2,076
Building Envelope	Thermographic scan of building exteriors & minor repairs	$1,508	$8,000	8,237	415
TOTAL		**$32,814**	**$279,550**	**177,247**	**10,382**

9.6 Halton Hills Cultural Centre and Library

Table 21 Halton Hills Cultural Centre and Library – existing condition and description of recommended measures

System	Existing Condition	Recommended Measures
Lighting	The lighting is typically LEDs and staff complains of overlit areas, especially in the library where ample daylighting is present.	Conduct lighting audit to ensure correct light levels and power densities. Convert fluorescent lighting to LED. Install photo- and occupancy-controls in accordance with Town standard.
HVAC	The building uses a geothermal loop to cool and heat the building with 8 Rooftop units, all controlled by the Metasys BAS. The Rooftop units have schedules and VFDs. The main exhaust fan has an ERV unit. The Geothermal pumps have VFDs and runs on duty/standby operation. There are complaints regarding air quality. The theatre is a high ceiling area and often takes a long time to cool or heat, experiencing a predominant stack effect with the lighting/audio/visual room emitting a large amount of heat. The art gallery requires humidification and has a standalone system; since it is part of the original building, insulation is poor.	Test air handling units, heat pumps and pumps to determine actual flows and pressures, rebalance, retrofit and refurbish accordingly. Monitor CO2 levels and adjust airflows and controls to maintain comfort conditions. Monitor art gallery unit, heat pump loop and other HVAC unit operation and make necessary control changes. Install destratification fans in theatre. Install destratification fans.

Table 22 Halton Hills Cultural Centre and Library – recommended measure cost and savings summary

System	Recommended Measures	Estimated Savings ($/yr)	Estimated Cost ($)	Electricity Savings (kWh/yr)	Gas Savings (m3/yr)
Lighting	Lighting audit, lighting retrofit, controls	$10,370	$42,420	60,997	
HVAC & Controls Retrofit/Geothermal Optimization	Performance testing		$25,000		
	Ventilation refurbishment	$8,538	$33,835	49,551	441
	Installation of destratification fans	$2,511	$18,000	14,574	130
	HVAC optimization	$17,884	$69,185	103,368	1,206
Building Envelope	Thermographic scan of building exteriors & minor repairs	$1,507	$10,100	8,744	78
TOTAL		**$40,809**	**$192,540**	**237,234**	**1,855**

10 APPENDIX C: DATA ASSUMPTIONS

GHG Emissions Factors

20 g CO2e per kWh of electricity (consumption intensity)
1,916 g CO2e per m3 of natural gas

Source: National Inventory Report 1990 - 2017: Greenhouse Gas Sources and Sinks in Canada (submitted in 2019) Part 3, Annex 13 Electricity in Canada: Summary and Intensity Tables

https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/national-inventory-submissions-2019

Utility Rates

Electricity	2018	0.17	$ per kWh	Source: 2018 inventory
Gas	2018	0.2583	$ per m3	Source: THH actual and projected rates
	2019	0.2655		
	2020	0.2559		
	2021	0.2409		
	2022	0.2737		
	2023	0.2848		
	2024	0.2906		
	2025	0.2956		
	2026	0.2956		
	2027	0.2956		

Escalation Rates

Electricity 5.9%
Gas No escalation rate applied; effective gas rates for each year applied as per note above.
Inflation rate 2.5%

Incentive Rates

Electricity $0.10 per kWh
Gas $0.20 per m3
Incentives are estimated based on current utility company offerings and are subject to change.

11 APPENDIX D: RECOMMENDED ORGANIZATIONAL ACTIONS

Category	Recommended action	Who	Priority
Asset Management	Update Corporate Asset Management Needs Assessment and project review process to include greenhouse gas emissions, energy efficiency, Low-Carbon Design Brief, fuel flexibility and considerations.	Corporate Asset Manager	High
Policies and standards	• Corporate Sustainable Building Policy should incorporate target efficiencies and low-carbon energy and mobility considerations • Update Green Development Standard to include low-carbon considerations and to have it apply to public and municipal new building design	Office of Sustainability, Corporate Energy Team	High
New Construction and Capital Improvements: Integrated design process	For all major renovations and new construction projects, use an integrated design process to determine the design and operation of the facility. This will involve getting everyone who will be involved in the project, from the design phase to construction to the actual day-to-day operations, together right from the start to collaborate.	Manager of Facilities, Sustainability Engagement Coordinator	Medium
Performance monitoring and reporting	Additional data recommended for collection includes: • Building automation system data • Lifecycle costing data in a Work Management System • Automatic vehicle tracking system or automatic vehicle location (AVL) system data • Electric vehicle (EV) charger use data • Performance indicators	Office of Sustainability, Manager of Facilities, Fleet Coordinator	Medium
Staff training and support	Incorporate the following in training: • Energy performance management principles • Use of Building Automation Systems to monitor operations and improve performance • Impact of operations and maintenance on energy efficiency in different building types • Building operator training on operation of installed geothermal systems once their design and operation has been documented and their performance has been optimized • Training on maintenance and operation of electric vehicles for fleet operations when purchase of electric fleet vehicles becomes possible • Low-carbon and building equipment-specific training when such systems are installed • Further green driving training once the AVL system provides feedback on fleet driving performance	Office of Sustainability, Manager of Facilities, Fleet Coordinator	Medium
Procurement	Undertake assessment and further development of the following: • Evaluation criteria for professional services • Standing Offer agreements with contractors • Outcomes-based service contracts	Procurement Manager	Medium
Occupant engagement	Once comfort issues have been addressed through building optimization, create and enforce a policy relating to temperature setpoints, operating schedules and use of personal appliances. Encourage and support walking, cycling, electric vehicles and ride-sharing.	Manager of Facilities	Low

Category	Recommended action	Who	Priority
Organizational capacity and resourcing	Additional resources will be required to meet the goals and implement the strategy outlined in the Plan, particularly relating to: • Creating annual goals and work plans • Developing approach and policy for evaluating and implementation of all sustainability measures • Identifying and managing the implementation of energy efficiency and low-carbon projects, including required measurement and verification processes and obtaining utility company incentives • Identifying and applying for federal, provincial and other funding sources • Managing staff training programs • Championing energy efficiency and low-carbon options with other stakeholders through capital planning, project development, procurement and other management processes • Monitoring and reporting on progress • Internal and external communications	Office of Sustainability	High
Geothermal design and operational standards	From study of current geothermal installations, develop design and operational standards for future installations in other Town facilities.	Office of Sustainability and Facilities staff	High
New building and major facility design considerations	When redesigning or designing a facility, consider: • Low-carbon design focused on reducing fossil fuel use • South-facing ventilation air intakes • "Solar wall" preheating • Solar readiness or solar installations • Alternative mobility considerations such as bike paths and parking, as well as transit or future transit • Electric vehicle charging station opportunities	Manager of Facilities, Facilities staff and Office of Sustainability	Medium
Low-Carbon Mobility subcommittee	Set up a Low-Carbon Mobility subcommittee to determine low or zero carbon mobility goals, how they impact vehicle purchasing, new facility design and electric vehicle (EV) infrastructure, as well as tracking ongoing progress against goals.	Fleet Coordinator, Office of Sustainability, Transportation Manager,	High
Telecommuting policy/strategy	Establish a telecommuting policy so employees can work from home and hold meetings by conference call. This will reduce employee travel time and have the additional benefit of providing more space flexibility at Town Hall.	Office of Sustainability, Sustainability Engagement Coordinator	Medium
Town staff engagement for electric vehicles	Develop engagement campaign to provide staff with information about electric vehicle rebates, possible Town incentives for owning an electric vehicle and provide the infrastructure for employees to charge electric vehicles at work.	Sustainability Engagement Coordinator	Low
Green Revolving Fund	Establish a Green Revolving Fund (GRF) as a means of establishing a predictable and accountable financing source for implementation of the Plan.	Office of Sustainability	High
Performance indicators	Measure and monitor identified performance indicators, as identified in the Plan.	Office of Sustainability	Medium

12 APPENDIX E: SAMPLE SETPOINT POLICY FOR POOLS

The following is a sample setpoint policy for pools that covers identified setpoints, the strategy for managing the setpoint, details and the referenced standard and/or guideline. The setpoint policy makes sure pools are operated consistently, safely and to minimize energy use.

Pool setpoints	Strategy	Details	Reference
Water temperature	As low as possible	Set according to relevant user group and programming between 78F-86F: Children swim class 84F Recreational swimming 80F-85F Competition 76-82F Keep hot tub temperature below 104F	WHO (Guidelines for safe recreational water environments); Aquatic Exercise Association (AEA) guidelines for water temperature
	Reset	At night stop or minimize water heating, continue circulating water as required Experiment with how long it takes to heat the water back up in the morning and use automatic control	
Space pressurization	Negative to surrounding	Keep a negative pressure (0.05-0.15 inches water column (WC)) in pool space to adjacent spaces. 10% more exhaust air than supply as rule of thumb.	ASHRAE; Seresco (natatorium design guide)
Space temperature and relative humidity (RH)	As high as possible within limits (relative humidity (RH)<60%) during heat reclaim, pending the caliber of building envelope	Increase space temperature and relative humidity to as high as comfort allows when no fuel heating is used (summer and shoulder seasons). Keep space temperature 2C above water temperature in heating season, while ensuring no condensation in the wall assembly	ASHRAE, CIBSE, Buildingscience.com
	Reset heating, cooling and dehumidification, as well as fan operation	Minimize HVAC operation (set VFD to minimum, continue heat reclaim if thermal wheel present, use a wider space temperature band for heating and cooling, reduce dehumidification to a level to ensure no condensation in the wall assembly). The reset can be enhanced with the use of a pool cover to reduce evaporation.	

13 APPENDIX F: LOW-CARBON DESIGN BRIEF

The Low-Carbon Design Brief is a new concept considered necessary to ensure that no/low carbon options are evaluated for every capital project and thereby avoid conventional designs for facility renewals and expansions and like-for-like equipment replacements. The Design Brief documents the end-point concept for each individual facility to provide the required services with the least possible carbon emissions. For new buildings, it is incorporated in the scope of work for the design team. For facility additions it ensures effective integration with existing building systems to deliver least-carbon whole-building performance. For equipment replacements it guides the Town and its designers and equipment suppliers in selecting the right equipment to fit into the long-term, low-carbon plan.

The elements of the Design Brief are as follows:

- The fundamental elements of the low-carbon design, including line diagrams and equipment capacities
- Internal heat recovery options from sources such as process equipment, IT and exhaust air and drain water, together with budget costs/incentives, net energy and emissions reductions and impact on heating equipment capacities. Budget costs are to consider economies associated with installation during end-of-life replacement projects
- External heat recovery options from sources such as solar thermal and geothermal with budget costs/incentives, net energy and emissions reductions and impact on heating equipment capacities/elimination
- Additional low-carbon and renewable energy considerations such as electric vehicle charging stations and solar readiness
- Lifecycle cost analysis including forecast costs of carbon offsets

14 APPENDIX G: LOW-CARBON FINANCIAL STRATEGY – GREEN REVOLVING FUND

The following section is a guide to establishing a Green Revolving Fund (GRF), should the Town consider this mechanism as part of its Low-Carbon Financial Strategy. A GRF would recycle utility cost savings, renewable energy revenues, incentive payments and operations and maintenance cost savings to fund the program. It would provide transparency and accountability to taxpayers as well as allow the Town to demonstrate leadership by example.

The GRF would be used to subsidize new energy/green initiatives and support additional staff and resources to complete energy retrofit projects and build organizational capacity. It can finance (in whole or in part) energy efficiency, renewable energy and other sustainability projects, energy studies, pilot projects and other similar energy related activities.

Potential benefits of a GRF:

1. **Creates a formal program of investment:** A GRF requires project clarity, fiscal discipline, accountability, transparency and a financing process that funnels savings from past projects into current spending plans.
2. **Demonstrates the business case for sustainability:** Rather than simply allowing the savings from energy efficiency projects to be absorbed into operating budgets, a GRF tracks the savings distinctly and directs them into future projects—thus creating a measurable return on investment (ROI).
3. **Recycles real efficiency improvements:** instead of using taxpayer dollars to fund the measures.
4. **Conveys reputational benefits** – A GRF can signal the municipal commitment to sustainability and operational efficiency.
5. **Catalyzes a culture shift**: A GRF represents a municipal commitment to larger strategic goals, such as greenhouse gas reductions, and provides a tangible vehicle for achieving them.
6. **Leverages savings into opportunity**: A GRF is great way to capitalize on the savings from energy efficiency projects to promote sustainability in general, whether or not they have financial paybacks.
7. **Tracks performance**: A GRF creates a streamlined process for an institution to distinctly track, manage, and analyze the financial and resource savings resulting from sustainability projects.

Best-practice GRFs rely on capturing cost savings to replenish the fund. It is recommended that the savings be calculated based on actual performance. This entails using a measurement and verification (M&V) approach to directly measure savings while accounting for factors like weather and usage. Some successful funds apply full utility cost avoidance (100% of the avoided operating utility costs, once realized, go towards the GRF) to pay off energy project investments. Variations on this model count smaller percentages of avoided costs going towards the fund and some do not include utility cost avoidance at all (relying on funding from grants and incentives).

Green Revolving Fund for the Town of Halton Hills

Energy efficiency measures identified in this Corporate Energy Plan will enhance building systems and facility operations, reduce maintenance costs and help the Town meet its net zero target. Incremental

costs for more efficient options could be financed by the GRF, providing a win-win scenario as less capital would be requested and lower operating costs will benefit operating budgets.

The development of a GRF for the Town should be an iterative and interactive process. Stakeholders would include the Manager of Facilities, Office of Sustainability, members of the Corporate Asset Management Steering Committee and the Asset Management Network Team. The goal of the initial round of discussions would be to identify barriers to establishing a GRF, develop a strategy for overcoming these barriers, lay the groundwork for building future support and refine the structure of the proposed fund to capture opportunities.

Project Criteria

Project criteria should promote the mission of the fund and be tailored to the actual portfolio of projects that are available for investment. The Town should consider flexibility in project requirements and may need to adapt as the portfolio of available projects changes over time or as unique opportunities arise. For example, a project may compensate for failing to meet financial goals by outstanding performance in other areas such as greenhouse gas reductions. In addition to specific criteria, projects should be prioritized in a way that best allocates limited resources while accounting for the feasibility and timing of projects given other constraints, such as staff availability.

Establishing Financial Flows

Finance staff have a unique understanding of the Town's accounting system and should be involved early in the GRF design process as their buy-in and expertise are crucial. Energy and climate change goals should be included in the current prioritization matrix and budget process, as well as the capital and project review process. It is recommended that the GRF be integrated with current Asset Management processes, including the Needs Identification and Assessment form used for project evaluation.

All stakeholders should also feel comfortable with the cash advance and repayment process. Before any project is undertaken, involved parties must understand:

- Who pays the project invoice, which account will they use and when those funds will be available;
- Which account will be receive repayments over the course of the loan, how often those repayments will occur and the total of each repayment as well as the overall repayment obligation
- How all of the flows of money will appear on the various departmental budgets and balance sheets.

Launching the Fund

Before launching the fund, the first round of funding will be planned (using the savings potential model from the Corporate Energy Plan 2020-2025 as a guide). As projects are being implemented, the planning process will continue for future phases of projects and applications, as well as for fund management, outreach and meetings of the team. Planning for the future is important to efficiently manage the fund, to ensure capital remains effectively invested, and to show stakeholders how the fund is progressing and demonstrate success. The fund should be formalized with a charter, memorandum of understanding, formal project criteria and other guiding documents made available to all stakeholders. The Town should consider developing a website for the fund to provide information about the fund, post official documents, provide tools and resources and report on progress internally and to the public.

Implementation
To reduce risk and build confidence, it is recommended that the Town undertake a soft launch in which the first round of investment targets projects that are expected to be straightforward. It is also recommended that the Town begin with a manageable fund size and scope, and scale it up over time as success is demonstrated.

Ongoing Management and Oversight of the Fund
The GRF should be managed by a committee of stakeholders including the Manager of Facilities, Senior Sustainability Planner & Energy Coordinator, Corporate Asset Manager and others, which could be a subcommittee of the Corporate Energy Team. Their support will be crucial in the fund development and implementation.

It is recommended that the Town allocate permanent staff time to devote to fund management and conduct due diligence on proposed projects.

The fund charter outlines how it will operate for internal and external stakeholders. The procedure for reviewing, evaluating, and selecting projects needs to be clearly specified and should actively engage the relevant staff. When assessing potential projects, the criteria may include both hard requirements and preferred attributes, such as payback, capital cost, specific environmental benefits such as greenhouse gas emissions reduction, cost-effectiveness metrics (such as greenhouse gas reduction per dollar of capital cost) and potential for community engagement and collaboration.

GRF funding
Initially, the proposed GRF could be funded through seed capital, incentives and grants where 100% of all energy efficiency project incentive money received will go into the fund.

Once the GRF is running smoothly, consideration could be given for including energy savings from energy efficiency projects. This would require ongoing monitoring and verification of energy savings and buy-in from all stakeholders. Other potential sources of funding include:

- Renewable energy installations
- Future electric vehicle charging station revenue

15 APPENDIX H: FUNDING SOURCES – FEDERATION OF CANADIAN MUNICIPALITIES

	Description	Target	Amount	Deadline to apply
1	**Capital project: Signature initiative** https://fcm.ca/en/funding/gmf/capital-project-signature-initiative			
	Combined loans and grants funding to implement bold environmental projects that reduce GHG emissions and protect the air, water or land. The capital project may involve any type of initiative, so long as it has the capacity to create transformative change in the energy, transportation, waste, water or land use sector (or a combination of those sectors).	Signature initiatives do not have pre-set environmental targets/thresholds because the projects are unique and evaluated on a case-by-case basis. Preference in projects that have built-in mechanisms to encourage replication and widespread adoption (e.g., innovative business models, partnership models, new financing mechanisms).	• Regular loans and grants: A low-interest loan of up to $5 million and a grant worth up to 15% of the loan; cover up to 80% of eligible costs. • High-ranking project loans and grants: These qualify for a low-interest loan of up to $10 million and a grant worth up to 15% of the loan; cover up to 80% of eligible costs.	Two-stage application process: Initial Review Form: August 1, 2019; Application by invitation only: October 1, 2019
2	**Capital project: Retrofit of municipal facilities** https://fcm.ca/en/funding/capital-project-retrofit-municipal-facilities			
	Funding for retrofits that improve energy efficiency by at least 30% in municipal facilities.	The combination of retrofits must reduce a building's energy use by at least 30%. A minimum of 20% must come from energy efficiency and a maximum of 10% can come from on-site, renewable energy. The 10% maximum does not apply to geothermal exchange systems. Retrofit changes must meet or exceed the national and provincial building codes (NECB 2011 or provincial derivatives).	• Regular loans and grants: A low-interest loan of up to $5 million and a grant worth up to 15% of the loan; cover up to 80% of eligible costs. • High-ranking project loans and grants: These qualify for a low-interest loan of up to $10 million and a grant worth up to 15% of the loan; cover up to 80% of eligible costs.	Two-stage application process: Initial Review Form: August 1, 2019; Application by invitation only: October 1, 2019
3	**Capital project: Energy recovery or district energy** https://fcm.ca/en/funding/gmf/capital-project-energy-recovery-district-energy			
	Funding for capital projects that use recovered or renewable thermal energy in new or existing facilities. The capital project must reduce energy use and GHGs by at least 40% by using recovered or renewable thermal energy in new or existing facilities, emissions (GHGs) and improves their air quality.	The initiative must reduce fossil fuel or grid electricity use by at least 40% compared to current performance. It must be able to achieve this target within three years of implementation.	• Regular loans and grants: A low-interest loan of up to $5 million and a grant worth up to 15% of the loan; cover up to 80% of eligible costs. • High-ranking project loans and grants: These qualify for a low-interest loan of up to $10 million and a grant worth up to 15% of the loan; cover up to 80% of eligible costs.	Two-stage application process: Initial Review Form: August 1, 2019; Application by invitation only: October 1, 2019

	Description	Target	Amount	Deadline to apply
4	**Capital project: New construction of energy-efficient facilities** https://fcm.ca/en/funding/gmf/capital-project-new-construction-energy-efficient-facilities			
	Funding for capital projects that target net zero energy performance in new municipal facilities. The capital project must include a combination of energy efficient measures that together, target net zero energy performance in a new municipal facility	The initiative must aim for **net zero** energy performance. That means any energy it requires must be generated through on-site, renewable or recovered power sources	• Regular loans and grants: A low-interest loan of up to $5 million and a grant worth up to 15% of the loan; cover up to 80% of eligible costs. • High-ranking project loans and grants: These qualify for a low-interest loan of up to $10 million and a grant worth up to 15% of the loan; cover up to 80% of eligible costs.	Two-stage application process: Initial Review Form: August 1, 2019; Application by invitation only: October 1, 2019
5	**Study: Retrofit of municipal facilities** https://fcm.ca/en/funding/gmf/study-retrofit-municipal-facilities			
	Funding for feasibility studies of retrofits that improve energy efficiency by at least 30% in municipal facilities.	The combination of retrofits must have the potential to reduce a building's energy use by at least 30%. A minimum of 20% must come from energy efficiency and a maximum of 10% can come from on-site, renewable energy. The 10% maximum does not apply to geothermal exchange systems. Retrofit changes must meet or exceed the national and provincial building codes (NECB 2011 or provincial derivatives).	Grant: Up to 50% of eligible costs to a maximum of $175,000	Applications are accepted year-round, though this offer will close when all the funding has been allocated
6	**Study: Energy recovery or district energy** https://fcm.ca/en/funding/gmf/study-energy-recovery-district-energy			
	Funding for feasibility studies of projects that use recovered or renewable thermal energy in new or existing facilities. The study may compare several options or assess one option's ability to reduce energy use and GHGs by at least 40% by using recovered or renewable thermal energy in new or existing facilities.	The initiative must reduce fossil fuel or grid electricity use by at least 40% compared to current performance. It must be able to achieve this target within three years of implementation.	Grant: Up to 50% of eligible costs to a maximum of $175,000	Applications are accepted year-round, though this offer will close when all the funding has been allocated.
7	**Study: New construction of energy-efficient municipal facilities** https://fcm.ca/en/funding/gmf/study-new-construction-energy-efficient-municipal-facilities			
	Funding for feasibility studies of initiatives that target net zero energy performance in new municipal facilities.	The initiative must aim for net **zero energy** performance. That means any energy it requires should be generated through on-site, renewable or recovered power sources	Grant: Up to 50% of eligible costs to a maximum of $175,000	Applications are accepted year-round, though this offer will close when all the funding has been allocated.

	Description	Target	Amount	Deadline to apply
8	**Pilot project: Retrofit of municipal facilities** https://fcm.ca/en/funding/gmf/pilot-project-retrofit-municipal-facilities			
	Funding for pilot projects of retrofits that improve energy efficiency by at least 30% in municipal facilities. Pilot projects assess solutions in real-life conditions. They evaluate either a small-scale version of a project or a full-scale, replicable version.	The combination of retrofits must have the potential to reduce a building's energy use by at least 30%. A minimum of 20% must come from energy efficiency and a maximum of 10% can come from on-site, renewable energy. The 10% maximum does not apply to geothermal exchange systems. Retrofit changes must meet or exceed the national and provincial building codes (NECB 2011 or provincial derivatives)	Grant: Up to $350,000 to cover up to 50% of eligible costs	Applications are accepted year-round, though this offer will close when all the funding has been allocated
9	**Pilot project: Energy recovery or district energy** https://fcm.ca/en/funding/gmf/pilot-project-energy-recovery-district-energy			
	Funding for pilot projects that use recovered or renewable thermal energy in new or existing facilities. Pilot projects assess solutions in real-life conditions. They evaluate either a small-scale version of a project or a full-scale, replicable version. The pilot may compare several options or assess one option's ability to reduce energy use and GHGs by at least 40% by using recovered or renewable thermal energy in new or existing facilities.	The initiative must reduce fossil fuel or grid electricity use by at least 40% compared to current performance. It must be able to achieve this target within three years of implementation.	Grant: Up to $350,000 to cover up to 50% of eligible costs	Applications are accepted year-round, though this offer will close when all the funding has been allocated
10	**Pilot project: New construction of energy-efficient municipal facilities** https://fcm.ca/en/funding/gmf/pilot-project-new-construction-energy-efficient-municipal-facilities			
	Funding for pilot projects of initiatives that target net zero energy performance in new municipal facilities.	The initiative must aim for a **net zero** energy performance. That means any energy it requires should be generated through on-site, renewable or recovered power sources	Grant: Up to $350,000 to cover up to 50% of eligible costs	Applications are accepted year-round, though this offer will close when all the funding has been allocated.

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Establishing and Operationalizing an Energy Efficiency Revolving Fund (http://www.worldbank.org/content/dam/Worldbank/Event/ECA/revolving.pdf)

Green Revolving Funds: An Introductory Guide to Implementation and Management (https://files.eric.ed.gov/fulltext/ED539859.pdf)

Energy Revolving Funds for the following Ontario municipalities: City of Guelph, City of Hamilton, Town of Caledon, City of Waterloo, City of Burlington, City of Pickering