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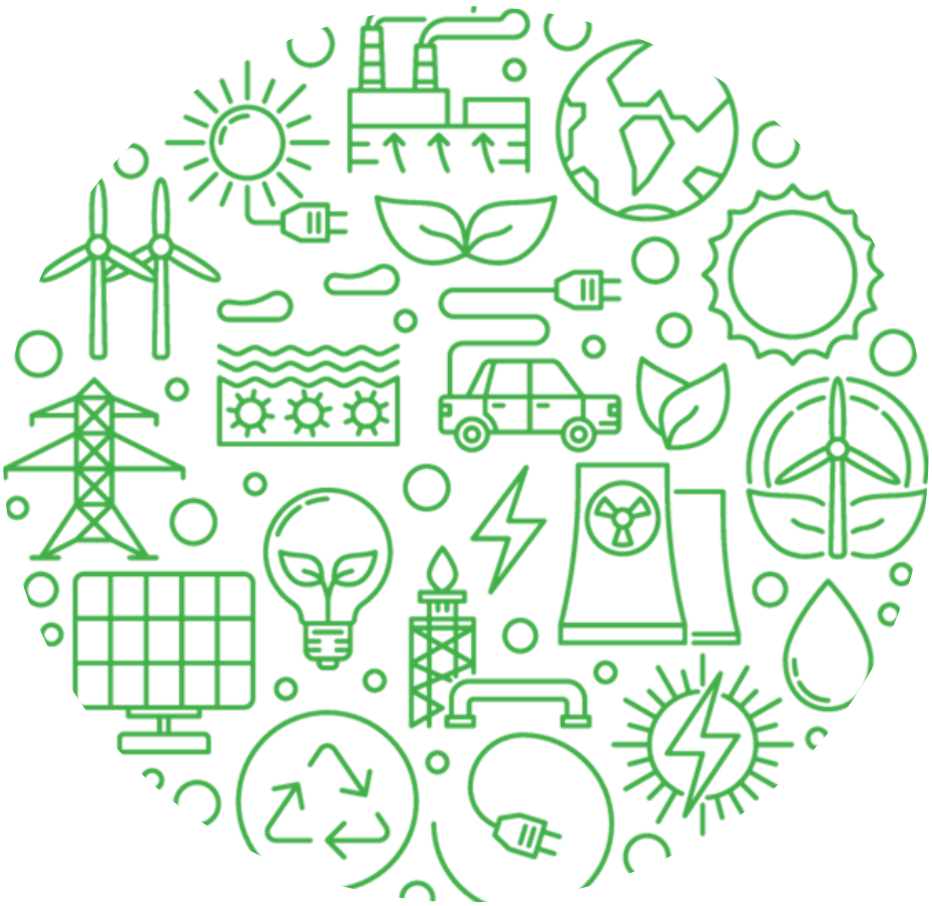

Green Fleet Strategy – Town of Wasaga Beach

November 19, 2024

This project was carried out with assistance from the Green Municipal Fund, a Fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

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ABC – Activity Based Costing; a costing method that identifies activities in an organization and assigns the cost of each activity to all products and services according to the actual consumption by each.

AEC – Annual equivalent cost

B10 – A blend of 10% biodiesel and 90% fossil diesel

BAU – Business-as-usual

EV – Battery-electric vehicle

CAC – Criteria air contaminants; a cause of ground level smog

CAFE – Corporate average fuel economy

CAPEX – Capital expense

CIF – Cost inflation factor

CNG – Compressed natural gas

CO_2 or CO_2e – Carbon dioxide or carbon dioxide equivalent

Downtime – Period when a vehicle is unavailable for use during prime business hours

ECM – Electronic control module

ELD – Electronic logging device

E85 – A blend of around 85% ethanol and 15% gasoline

EV – Electric vehicle

EVSE – Electric vehicle supply equipment

FAR – Fleet Analytics Review (Excel software tool)

FMIS – Fleet Management Information System

FTE – Full-time equivalent (employee)

GHG – Greenhouse gas (expressed in CO_2 equivalent tonnes)

GHG Intensity – A measure of GHGs produced relative to VKT or VMT (see below)

HDRD – Hydrogenation Derived Renewable Diesel

HD or HDV – Heavy-duty vehicle (Classes 7 - 8)

HEV – Hybrid-electric vehicle

ICE – Internal combustion engine

KPI – Key performance indicator

LCA – Lifecycle Assessment

LD or LDV – Light-duty vehicle

LPG – Liquified petroleum gas, more commonly referred to as propane

LTCP – Long-term capital planning

MD or MDV – Medium-duty vehicle

MT – Metric tonne

MVIS – Motor Vehicle Inspection Station

NPV – Net present value

OEM – Original equipment manufacturer

OPEX – Operating expense

PHEV – Plug-in hybrid electric vehicle

PM – Preventative maintenance

PMCVI – Periodic mandatory commercial vehicle inspection

ROI – Return-on-investment

SSC – Safety Standards Certificate

Solution – A technology, best management practice, or strategy to reduce fuel use and GHGs

TCO – Total cost of ownership

Uptime – Period when a vehicle is available for use during prime business hours (opposite of downtime)

VKT or VMT – Vehicle kilometres/miles travelled

WACC – Weighted average cost of capital

ZEV – Zero-emission vehicle

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Analysis in this report is based on fleet data prepared and submitted by the Town of Wasaga Beach. Deloitte is not responsible for errors or omissions, or the results obtained from using this data. Where data gaps existed, Deloitte employed proxy data based on Canadian municipal fleet averages as a workaround.

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Executive Summary

On November 20th, 2023, the Town of Wasaga Beach enlisted the services of Fleet Challenge Canada Inc. (FCC) of Toronto to formulate a Green Fleet Strategy and provide recommendations for its fleet and equipment assets. On November 17, 2023, FCC merged with Deloitte, and this unified team now presents this report to comprehensively review and provide recommendations for the Town of Wasaga Beach's first Green Fleet Strategy.

The development of the Green Fleet Strategy commenced with a thorough examination of the Town's current operations, utilizing virtual meetings, a comprehensive questionnaire, and a process of combining all fleet data into one data sheet. Subsequently, baseline and lifecycle assessments were conducted, based on a one-year snapshot from 2023, providing information on the historical GHG emissions, costs, and service level metrics, including utilization and availability. Optimal replacement lifecycles were then calculated for each unit, vehicle, and equipment category. Simultaneously, an in-depth investigation into replacement cycle policies across diverse cities and municipalities enhanced the robustness of the analyses, ensuring a comprehensive and well-rounded perspective on fleet management practices. Following this initial phase, stakeholder engagement was initiated to gather feedback from various internal groups. Stakeholder opinions were collected through a confidential online survey designed to identify concerns, suggestions, and potential barriers. Subsequent steps encompassed predictive data modeling, long-term (15-year) capital planning, determining the optimal replacement vehicle fuel type, a Green Fleet phase-in plan, and Electric Vehicle Supply Equipment (EVSE) planning. The culmination of these steps resulted in meticulously researched recommendations and a comprehensive implementation plan for the Town.

Key Findings from Modelling

The assessment was initiated by establishing a baseline capital expenditure, operating expenditure, and GHG emissions to provide a comprehensive overview of the Town's current fleet operations. The report is based on a data analysis of one-year of historical data (2023) for 173 Town of Wasaga Beach fleet units including vans, SUVs, light-duty pickups, heavy-duty trucks, and mobile equipment. The calculated base year (2023) GHG emissions for the Town's fleet was 1,143 MTCO2e.

Using a thorough comparative analysis with 24 other Ontario peer fleets, the Town showcased a slightly older average age during the baseline year. Key performance indicators, such as a high proportion of light-duty vehicles contributed to a lower cost per kilometer and an average emissions per kilometer approximately 36% less than the benchmark for on-road vehicles. A low population ratio of 235 residents/vehicle versus the benchmark of 974 also positions the Town favourably as the Town grows rapidly over the next few decades.

Some key metrics brought attention to potential areas for improvement, particularly the higher-than-expected capital cost for vehicle replacements in 2024, which is significantly greater than the average year for the Town (see Figure 1). This is at least partially the result of vehicle replacement carryover caused by COVID-19-related supply chain issues from 2020 to 2023 in the automotive industry. This may also suggest a need to increase the replacement life of the fleet's vehicles and balance the forecasted budget. Additionally, the average fuel cost of the Town's on-road units is approximately 23% higher than the average comparative municipality. Although this difference is most likely due to the elevated fuel prices over the past two years, it does highlight an increasing benefit of converting the fleet to electric, which in turn would reduce fuel costs.

The capital expenditure (CAPEX) investment over the next 15 years exhibits several spikes, uneven spending year-over-year which may hinder the Town's ability to plan budgets effectively (see Figure 1). The total replacement value of the fleet is currently $27.0M. The Fleet Analytics Review (FAR) modelling tool estimated that in 2024, the Town would need to invest $8.90M to replace all vehicles and equipment due for replacement based on its current replacement practices. Given the average expected CAPEX is $2.20M, the 2024 required investment is quadruple the average annual capital expenditure and should be balanced with other years.

In 2021, prior to automotive supply chain issues impacting the Town's fleet, a vehicle/equipment acquisition forecast for 2022 to 2034 was created by the Town. Replacement costs never exceeded $5.0M per year within the forecast, with 2022, 2023, and 2024 costing $2.33M, $,4.77M, and $2.65M, respectively. Since carryover did not appear to be impacting the Town in 2021, the present day forecast that requires an investment of $8.90M in 2024 is most likely a result of procurement problems that accumulated over the past several years.

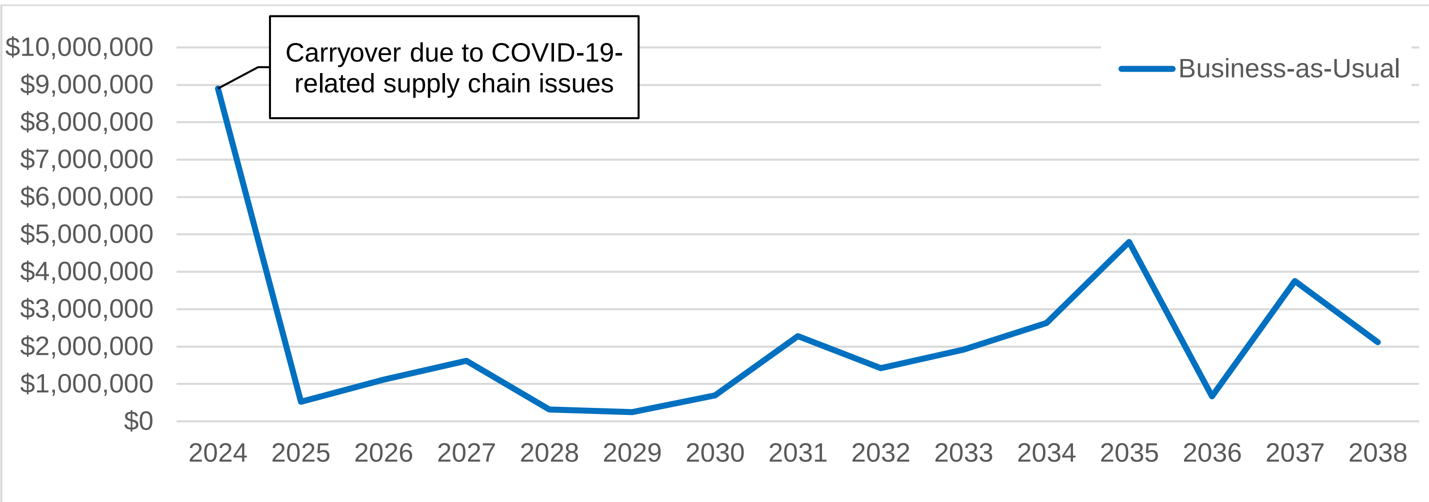

Figure 1. Baseline 15-Year CAPEX with Business-as-Usual Lifecycles

The subsequent step in the assessment involved determining the optimal replacement lifecycles for various vehicle categories. The analysis determined that extending the lifecycles of class 1 SUVs from 7 to 10 years, class 2 pickups from 7 to 12 years, firetrucks from 13 to 17 years, and class 8 trucks from 11 to 14 years would be optimal for minimizing the annual cost of ownership (please see appendix F for more weight classification information). It is important to note that the Town does have a surplus pool of vehicles that older vehicles, or vehicles in poor condition, are added to near the end of their life. These vehicles are then used infrequently by full-time employees and/or used specifically in the summer by seasonal workers. This does extend the life of some of the fleet's vehicles past their current planned lifecycles. However, the model assumes the replacement schedules are followed without a vehicle pool. Incorporating these new lifecycles into the planning tool, the model was adjusted to lessen the variance in the planned capital spending based on unit conditions and ROI. This approach aims to lessen the variance in annual CAPEX (see Figure 2).

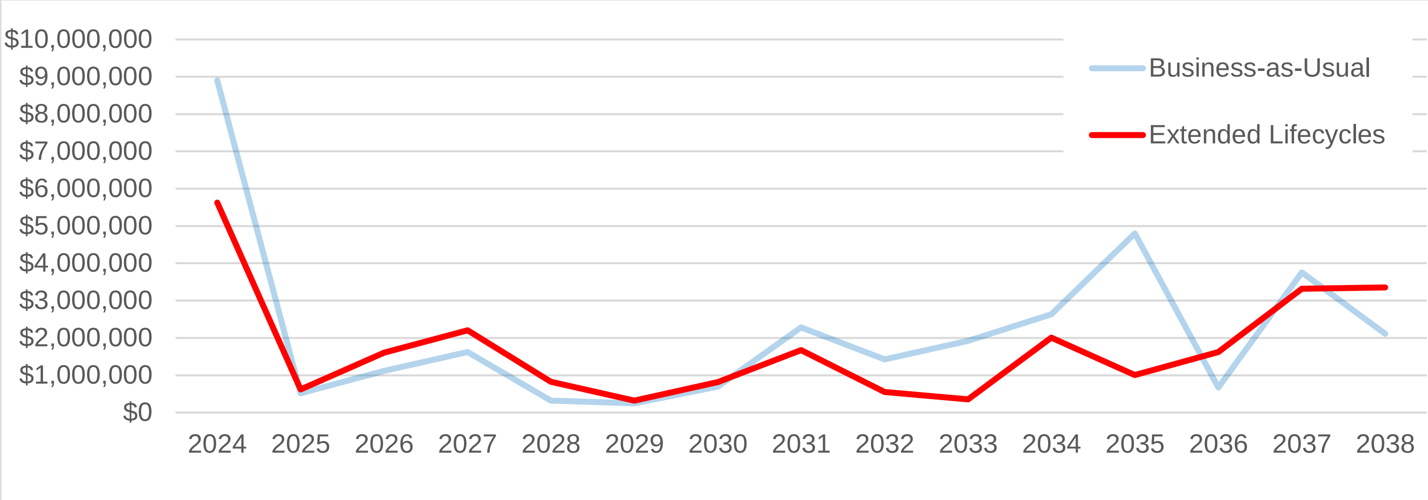

Figure 2. 15-Year CAPEX with Extended Lifecycles

Although this adjustment reduced the variance, the extended lifecycles still do not create a sufficiently balanced capital budget. The optimized lifecycles are based on the average financial investment and operating costs of different classes of fleet vehicles; however, the condition of individual vehicles must be assessed prior to making the decision to replace end-of-lifecycle vehicles. Condition ratings should always take precedence over other metrics that may determine replacement timing, such as the age or the mileage of the vehicle.

The Town currently extends vehicle lifecycles based on condition but there is no formal condition rating procedure in which the ratings are recorded. For this reason, vehicle replacement schedules were manually adjusted (hypothetically, for data-modeling purposes) based on the condition of the vehicles. Condition ratings were collected for each vehicle, allowing for vehicle-specific lifecycle extensions when the vehicle is in good condition. This resulted in a new and balanced capital budget (see Figure 3).

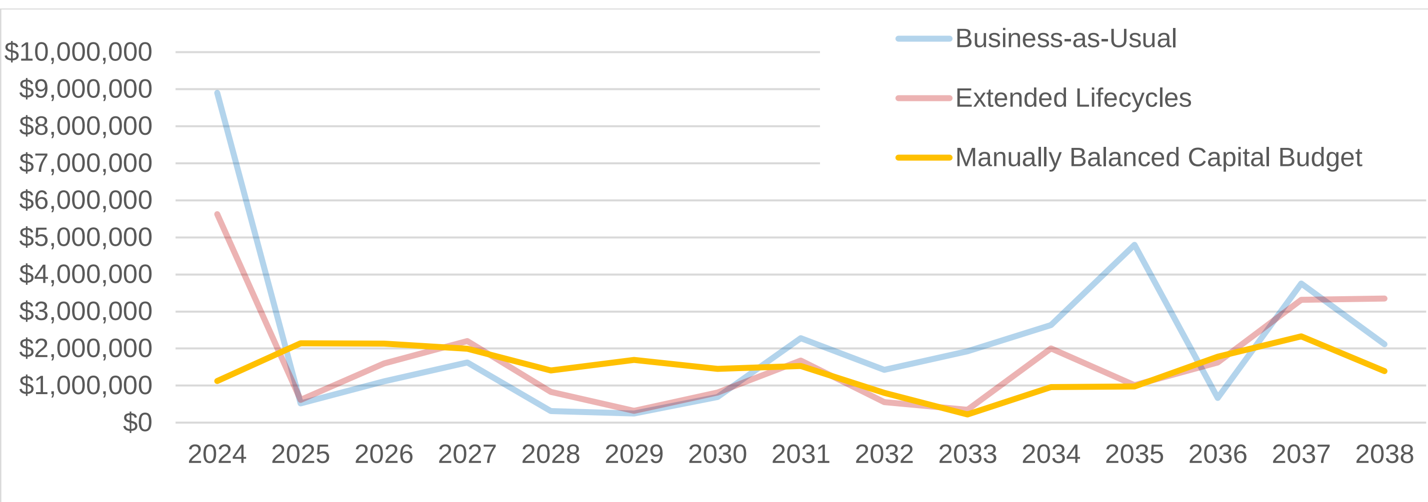

Figure 3. 15-Year CAPEX with Extended and Manually Adjusted Lifecycles

Next, alternative fuel-types were explored and outlined in the report, including the consideration of hydrogen, compressed natural gas (CNG), electric, and hybrid electric vehicles. Ultimately, electric vehicles were concluded to be the most cost-effective while being the most impactful on reducing GHG emissions. One of the determining factors was the results of the long-term transition model to introduce battery electric vehicles (BEVs), named the Green Fleet Strategy Model. This model illustrates the potential scenario when existing and qualifying Internal Combustion Engine (ICE) and hybrid units are replaced with BEVs (see Figure 4). While the initial investment in battery electric vehicles represents a material upfront cost, the introduction normally contributes to a reduction in operating and maintenance expenses over time. This analysis indicated that the Town would need to phase-in 96 electric vehicle replacements, as well as Level 2 (L2) and Level 3 (L3) chargers, from 2024 to 2038.

Although the Green Fleet Strategy increases the replacement value of the entire fleet from $27.0 M to $31.0 M, It is worth noting that these replacement costs do not reflect available grants and incentives for electric vehicles such as the Medium- and Heavy-Duty Zero-Emissions Vehicles (iMHZEV) Program which provides up to $200,000 in incentives per vehicle[1], the Zero-Emission Vehicles (iZEV) Program which provides $5,000 in incentives for light-duty vehicles[2], or the Zero-Emission Transit Fund which shares 50% of the cost for transit vehicle purchases[3] (see Appendix E)

The average annual CAPEX within the Green Fleet Strategy is $1.97M, which is lower than the Business-as-Usual (BAU) Model, but greater than the models that incorporated changes in lifecycles. It is important to note that this does not include the initial infrastructure investment that is required. Over a 15-year period, this investment in Level 2 (L2) and Level 3 (L3) is estimated to cost an average of $190,000 per year. The resulting CAPEX forecast, not including charging infrastructure, is illustrated in Figure 4.

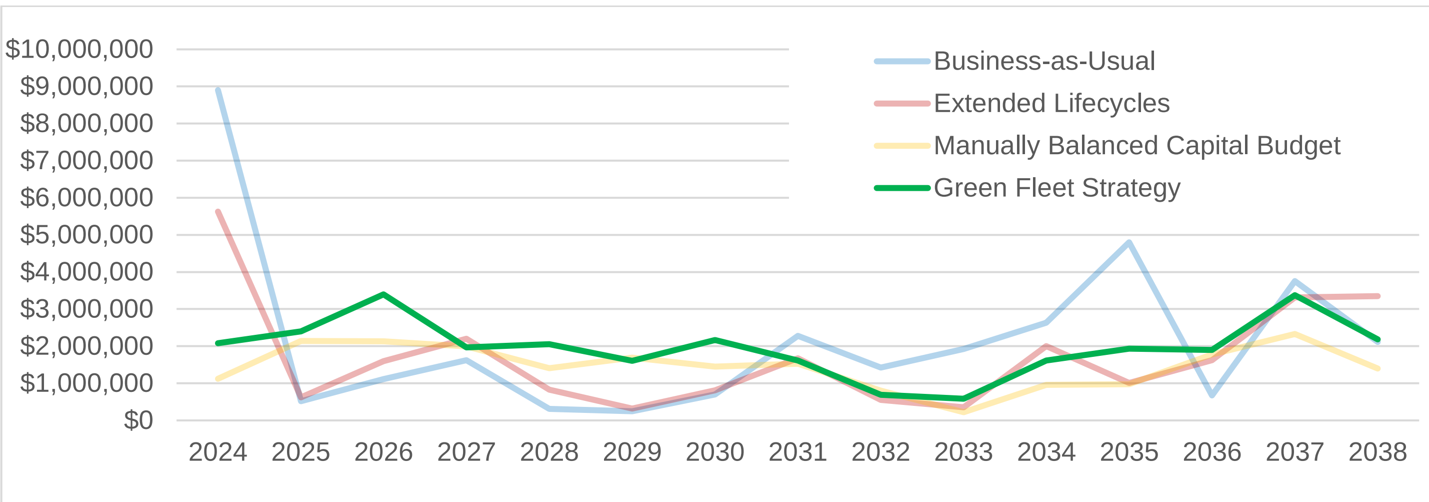

Figure 4. 15-Year vehicle CAPEX with Green Fleet Strategy

Subsequently, tailpipe GHG emissions are expected to reduce dramatically with the implementation of the Green Fleet Strategy. Relative to the 2023 emissions baseline, with full implementation of all EVs recommended in this report, the Town's fleet-related emissions are forecasted to decline by up to 60%, from 1,143 MT CO2e to 450 MT CO2e, as shown in Figure 5.

[1] Source: https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles
[2] Source: https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/incentives-zero-emission-vehicles-izev
[3] Source: https://www.infrastructure.gc.ca/zero-emissions-trans-zero-emissions/index-eng.html#2

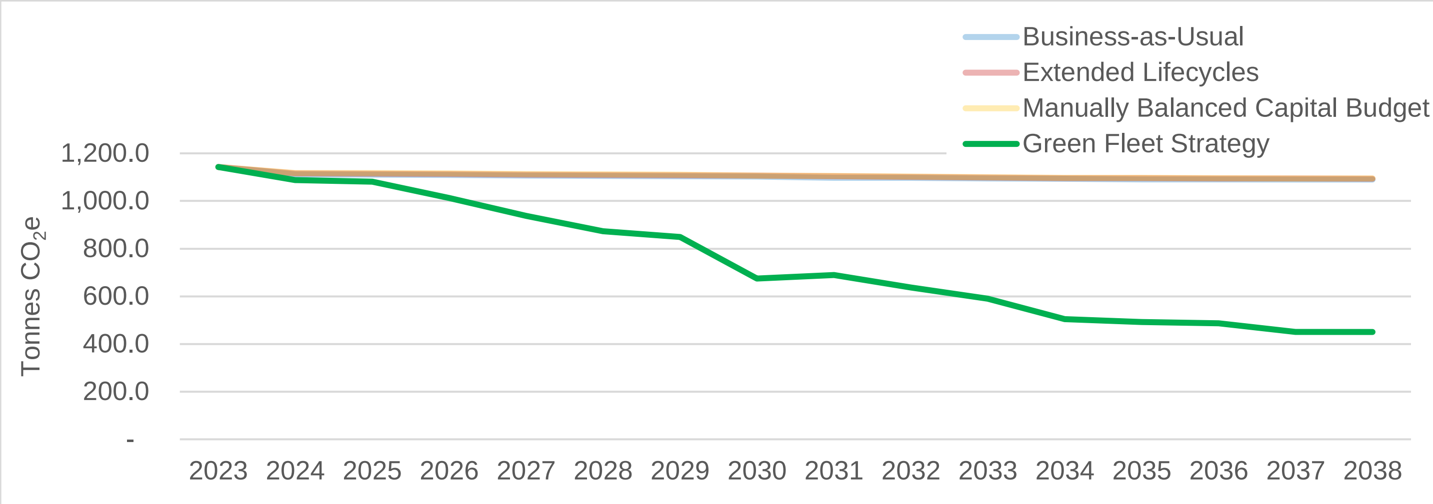

Figure 5. GHG emissions of the Green Fleet Strategy through time relative to the prior models

To summarize the findings of the models, the key outputs collected included CAPEX, OPEX, and GHG emissions in order to compare each scenario (see Table 1). The Manually Balanced Capital Budget Model was the best plan for minimizing average annual net expenses, with the net expenses being $4.79M a year. To compare, the Green Fleet Strategy forecasts average annual net expenses of $5.12M, but does not account for the significant incentives available for BEVs, or the decreasing cost of electric vehicles through time[4].

Table 1. Summary of key outputs from all four models

Category	Business as Usual	Extended Lifecycle	Manually Balanced Capital Budget	Green Fleet Strategy[5]
Average Annual CAPEX	$2.20M	$1.73M	$1.46M	$1.97M
Average Annual OPEX	$2.95M	$3.26M	$3.33M	$3.15M
Average Annual Net Expenses (CAPEX and OPEX)	$5.15M	$4.99M	$4.79M	$5.12M
Estimated 2038 GHG Emissions (MT CO2e)	1,090	1,094	1,095	450

An Electric Vehicle Supply Equipment (EVSE) model was also created for the Town to forecast the capital required to purchase and install Level 2 (L2) and Level 3 (L3) chargers, depending on the annual vehicle energy demands, battery size, vehicle acceptance rates, and other factors. This resulted in an average cost of equipment and installation of approximately $179,800 per year[6]. This figure does not take into consideration the grants and incentives available for the Town, including the Zero-Emission Vehicle Infrastructure Program (ZEVIP), which would be approximately 50% of the total project cost[7].

[4] Source: https://www.bls.gov/opub/btn/volume-12/charging-into-the-future-the-transition-to-electric-vehicles.htm
[5] Does not account for any grants or incentives for the purchase of electric vehicles
[6] Does not account for any grants or incentives for the purchase of charging infrastructure
[7] Source: https://natural-resources.canada.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876

Recommendations and Best Practices

Drawing from the management and operating practices interview, driver and management surveys, and the Town's fleet data, numerous recommendations have been identified, each with an implementation timeframe and priority level. The following table provides an overview of pivotal recommendations outlined in the report, providing a concise overview of strategic measures to enhance the Town of Wasaga Beach's fleet operations and considerations to ensure success in implementing a Green Fleet Strategy. The implementation timeframe is divided into two segments: short-term (0-5 years) and medium-term (6-10 years). Priorities are assessed on a scale of 1 - 4, with 4 indicating the highest importance and significance.

Table 2. Key Recommendations

Topics	Key Recommendations	Implementation Timeframe	Priority (1-4)
Asset management and Specifications	1) *Refine and update vehicle lifecycles based on the outcomes of the lifecycle Assessment (LCA) and policies best practices.*	Short-term	**4**
	2) *Consider recommended manual CAPEX balancing based on established condition ratings of vehicles to assess vehicle and equipment conditions effectively.*	Short/Medium-term	**3**
	3) *Efficiently manage the utilization of the fleet, ensuring that vehicles are utilized optimally and aligned with operational requirements.*	Medium-term	**2**
	4) *Right-size the fleet by matching vehicles precisely to job requirements, promoting cost-effectiveness and operational efficiency.*	Short-term	**2**
	5) *Install chargers at specific locations according to the EVSE installation schedule. Take into account the level of the charger and whether it is power sharing to ensure optimal charge rates.*	Medium-term	**4**
	6) *Consider creating a log of condition rating of vehicles to be kept by the Fleet Manager and updated at each maintenance event or shop visit. For higher annual mileage vehicles in the fleet, it is recommended that the Town reviews the condition of high mileage vehicles at thresholds of 20,000 km/yr for light-duty vehicles (LDVs) and*	Short-term	**2**

	25,000 km/yr for medium- and heavy-duty vehicles (MHDVs) for potential early replacement.		
	7) The Town should continue to purchase vehicles, rather than lease or rent vehicles.	Medium-term	**1**
Financial	*1) Fleet manager should issue quarterly departmental fuel and GHG emissions reports to inform and empower department heads in increasing the fuel efficiency of their assigned vehicles, reducing consumption, and associated emissions.*	Medium-term	**1**
Green Fleet Strategy	*1) Establish clear and measurable sustainability goals with specific KPIs, including targets like reducing carbon emissions (using the Green Fleet Strategy forecasted emissions as a guideline, depending on the Town's level of implementation), achieving a participation rate of x% in driver training programs for fuel-efficient driving, and increasing the use of alternative fuels to constitute x% of the total fuel consumption.*	Short-term	**2**
	2) Gradually commence the fleet transition to EVs with a pilot program that emphasizes monitoring performance through telematics, collecting driver feedback, and assessing the integration of BEVs into daily operations.	Short-term (*quick win)	**4**
	3) Explore funding opportunities provided by NRCan's Zero Emission Vehicle Infrastructure Program (ZEVIP program), Infrastructure Canada's Zero Emission Transit Fund, Transport Canada's Incentives for Medium- and Heavy-Duty Zero Emission Vehicles Program (iMHZEV program), and other grants and incentives listed in the report.	Short-term (*quick win)	**4**

	4) *As a short-term solution for GHG emission reduction, explore the use of biodiesel, invest in idling-reduction technologies, and explore the use of eco-friendly shop practices.*	Short-term	**1**
	5) *Electric buses should be considered in the future if daily mileages of the Town's buses decrease or if electric buses available to be purchased increase in range.*	Medium-term	**3**
	6) *If operationally possible, consider having pairs of low mileage vehicles at the same location take turns using chargers at night to save on charger equipment and installation costs.*	Short-term	**1**

The recommendations outlined are insights aligned with best practices, emphasizing the use of models such as the Fleet Analytics Review (FAR) to inform decision-making processes. The Green Fleet Strategy results from capital expenditure balancing and utilizes battery electric replacements. Another essential tool, the Electric Vehicle Supply Equipment (EVSE) tool, involves introducing 88, Level 2 (L2) chargers and 9, Level 3 (L3) chargers, over a 15-year period. This results in an average estimated cost of $180,000 per year, assuming a cost per L2 charger of $17,130 per L2 charger[8] and $99,800 per L3 charger[9], while also accounting for inflation. This L2 cost per charger estimate is slightly conservative relative to Evolute Power's estimates illustrated in Appendix G, which quotes $69,230 + tax ($78,230) for five L2 chargers at the Operations Yard in 2024.

The recommended Green Fleet Strategy suggests commencing the integration of 8, L2 chargers in 2024, enabling the Town to smoothly begin a transition to electric vehicles with a balanced investment over the 15 years.

[8] Based on Wasaga Beach's past L2 charging projects' supply costs and installation/trenching costs, on a per charger basis (rather than on a per dual pedestal basis)
[9] Based on the price of a FLO SMART DC 100kW charger supplied by Honda E Quipt, plus the installation/trenching costs that Wasaga incurred on their previous L3 charger

Background, Scope, and Objectives

Background: As stated in the Town's RFP # FL 2023-10, the Town of Wasaga Beach sought to develop the Town's first Green Fleet Strategy. The purpose of the project is to assist the Town in creating strategies and benchmarks to initiate a green fleet process, given current and future industry trends and technologies. Additionally, the goal of the study is to explore and evaluate lower carbon fuel alternatives that can reduce the fleet's GHG emissions.

Located in Simcoe County, Ontario, Canada, the Town of Wasaga Beach is a region celebrated for its natural charm. The Town is home to around 25,000 permanent residents and covers an area of approximately 57 square kilometers[10]. This population increases in the summer, and the Town is planning for a doubling in population by 2050.

The Town consists of thirteen departments that have assigned vehicles, which includes Arena, Beachfront, Building, By-Law, Engineering, Fire, Hydro, Library, Parks, Public Works, Recreation, Events, Facilities, Transit, and Water & Sewer department.

For this Green Fleet Strategy, a total of 173 fleet units were assessed, which includes vehicles and mobile equipment. These units encompassed a variety of vehicles and equipment, such as vans, SUVs, light-duty pickups, heavy-duty trucks, 12 – 24 seater buses, lawn mowers, trailers, ice resurfacers, and attachments. To gather valuable insights for this study, discussions were conducted with key personnel, including the Fleet Manager of the Public Works Department, the General Manager of Community Services, and the Fleet Manager of Wasaga Distribution.

Scope: The Town of Wasaga Beach sought qualified professionals to deliver consulting services for a comprehensive Green Fleet Strategy. The goal of the project was to define a clear pathway to electrifying the Town's fleet in order to reduce GHG emissions, energy consumption, and energy costs. Additional factors were considered, such as the cost effectiveness, market readiness, availability of capital, charging infrastructure, operations logistics, and required training.

Objectives: The Green Fleet Strategy has been developed based on the following activities:

- *Provide a baseline analysis of the current fleet sorted by size, industry, category, usage, ideal lifecycle/replacement date, market, and replacement value. Vehicle classification, fuel type, manufacturer, and department are also included.*
- *Benchmark current and long-term green fleet strategies of similar sized municipalities and similar industries to determine areas of improvement within the Town of Wasaga Beach's fleet.*
- *Verify and create Town of Wasaga Beach fleet GHG emission values in order to establish trends and recommend actions necessary for the Town to move towards lowering GHG emissions.*
- *Create a vehicle and equipment replacement schedule/funding plan for the Town to achieve a green fleet as well as GHG emissions reduction targets. Also, provide a comparator difference between existing replacement like-for-like forecasted costs anticipated for greening initiatives. Straight-line depreciation included in the funding plan and salvage value for greening versus existing fuel types.*
- *Provide analysis of vehicles comparing ICE, hybrid, PHEV, BEV, fuel cell, CNG, biofuels, and any other alternatives to determine the most cost effective vehicle replacement options.*

[10] Source: 2021 Canada Census

- *Provide a current market scan of CNG, diesel, ICE, BEV, PHEV, fuel cell engines and compare offering between each industry category. Public Works, Parks & Recreation, Transit, By-Law, and Building divisions are all to be included.*
- *Evaluate existing hydro capacities at existing municipal facilities and operations yards to confirm capacity and ability to accommodate EV charging infrastructure. Develop strategy and/or phased approach, including costing, to manage transition towards an electrified fleet.*
- *Consider the Town's existing charging infrastructure to identify gaps with the proposed green fleet growth rate. Consider public EV growth and how it will impact the Town's charging infrastructure growth plan.*
- *Dialogue with neighboring municipalities if there are opportunities to partner on upgrades such as fueling/charging stations.*
- *Provide data on vehicle efficiencies and drawbacks when operating in extreme weather environments for both summer and winter operations.*
- *Analyze tools and equipment and determine suitable replacement options. Equipment upgrades must meet or exceed current service level requirements and consider the operating time, charging time, power requirements, operator ergonomics, battery specifications, and replacement cost.*
- *Provide pilot program recommendations for large capital replacements such as like for like comparisons of ICE and EV offerings.*
- *Consider leasing or rental strategies for vehicles allowing the Town to make the best purchase decision at the correct time to align with new technologies.*
- *Provide recommendations for vehicle/equipment storage and charging at various yard locations. Evaluate alternatives such as upgrading outlets to charge vehicles and equipment, solar panels/wind turbines to charge vehicles and equipment batteries.*
- *Provide a review of the Town's current EV charging infrastructure for fleet vehicles and provide guiding documentation on future charging needs.*

Approach and Methodology

Detailed Approach

Step 1: Management and Operating Practices Questionnaire

The initial phase of the Green Fleet Strategy involved a comprehensive assessment of fleet management and operating practices. This step is a process that was designed to gain insights into the fleet's operational principles, business processes, policies, governance, reporting structure, and corporate objectives. The questionnaire delves into 13 key focal points, addressing over 100 fleet management topics. This systematic discovery process assesses the strengths, identifies potential process gaps, evaluates areas of risk or non-compliance, and highlights opportunities for implementing new best management practices. The goal of this step was to enhance the Town's financial, environmental, and service level performance, aligning with "best-in-class" standards of excellence.

Step 2: Stakeholder Engagement and Change Management

In the next step, the focus was on gathering insights from all user groups to understand their concerns, suggestions for improvement, and potential barriers from an end-user perspective. To facilitate this, the Qualtrics™ online survey platform was used, allowing participants to share their thoughts using desktops, laptops, or iOS/Android smartphones.

Fleet stakeholder feedback is particularly crucial because seemingly minor changes in the status quo may raise concerns for some Town employees. This is especially true for fleet vehicle drivers and equipment operators who may have strong attachments to their assigned vehicles and equipment. It is essential to recognize and address these concerns, as stakeholder buy-in and engagement are pivotal for the success of the Green Fleet Strategy and any recommended changes under consideration by the Town's management. Many employees appreciate being involved in discussions about potential changes, and their input is valuable in shaping the way forward.

Step 3: Baseline Analysis

The baseline analysis of the Town fleet's historical cost data enables an understanding of the current state. Utilizing the Fleet Analytic Review (FAR) tool, the fleet's current-day baseline is calculated, including fuel consumption, kilometers traveled, maintenance and reactive repair costs, service levels (e.g., availability and utilization rates, etc.), fleet size assessment (e.g., the ratio of vehicles relative to population and service area), and greenhouse gas emissions (GHGs) using the most up-to-date fuel emissions factors from the Government of Canada.

A) Baseline, Business-as-Usual Analysis, Risk Analysis

A go-forward scenario from the baseline was plotted based on business-as-usual (BAU) assumptions, including current-day vehicle procurement practices and lifecycles. To study financial service levels, all subsequent FAR analyses were modeled and compared to the business-as-usual scenario. Changes to the fleet's current-day practices, ranging from best management practices to long-term capital budget planning to vehicle selection options (e.g., gas vs. diesel vs. electric), were evaluated one-by-one.

B) Fleet Right Sizing and Downsizing

Ensuring the fleet is right-sized is critical in a fleet review, striking a balance between having enough vehicles for peak times and avoiding excess costs and emissions from an oversized fleet. The review included an assessment of fleet size, considering the total number of vehicles relative to the serviced area and the ratio of residents to fleet vehicle count. Comparisons with similarly sized fleets and identification of low- and high-utilization exception units guided recommendations for optimal alternatives and options. Downsizing principles were also applied to vehicle sizes, moving away from outdated guidelines, resulting in potential reductions in capital and operational expenses and overall fleet emissions.

C) Municipal Peer Fleet Database

Maintaining a unique peer fleet statistical benchmarking database allows the comparison of data from over 50,000 vehicle operating statistics from past fleet reviews for various Canadian municipalities and corporations. The database includes nearly 100 key performance indicators (KPIs) covering operational factors and service level indicators. These peer fleet comparisons are instrumental in identifying areas where the Town can enhance its fleet operations, leveraging insights from a broad spectrum of municipal fleets.

D) Gap Analysis

The municipal database's performance indicators facilitated gap analysis, positioning the Town’s fleet relative to peer fleets. Distinctions between urban and rural fleets were considered, providing valuable insights into operating considerations, characteristics, and costs. Comparative data from select Canadian peer fleets helped identify potential gaps, aiding in the formulation of recommended strategies for the Town management’s consideration.

E) Exception Management and Internal Benchmarking

Calculating category average performance for each vehicle and equipment type enables the assessment of individual units relative to average statistics for similar vehicles in the fleet. Exception units, exhibiting better or worse performance than comparable vehicles, were identified. Exception management serves as a powerful tool for informed decision-making regarding vehicle acquisition, standardization, lifecycle management, and best management practices. It also offers insights into driver behaviors, vehicle reliability, aging, availability, utilization, total cost of ownership (TCO), preventive maintenance practices, and greenhouse gas emissions.

Step 4: Lifecycle Assessment

As an integral component of fleet review processes, a comprehensive Lifecycle Assessment (LCA) was conducted for major fleet vehicle categories to find the optimal life of the vehicle-types based on cost of ownership forecasts.

Considering historical cost data, the LCA provides insights into when units should be considered for replacement. For enhanced precision and thorough analysis, previous project benchmarks for maintenance costs were employed to address data gaps and obtain a comprehensive understanding of costs throughout a vehicle's lifetime. Additionally, to stay aligned with industry best practices, a research study was conducted to gain insights into the strategies and policies employed by other fleets. These findings were crucial in formulating recommendations that align with current industry standards.

It is essential to note that, as shown in Figure 6 below, the optimal replacement of vehicles should occur before costs escalate, reliability/safety is compromised, and capital expenditure or refurbishment becomes necessary. This strategic approach aligns with the commitment to maximizing operational efficiency. More information about LCA can be found in Appendix A.

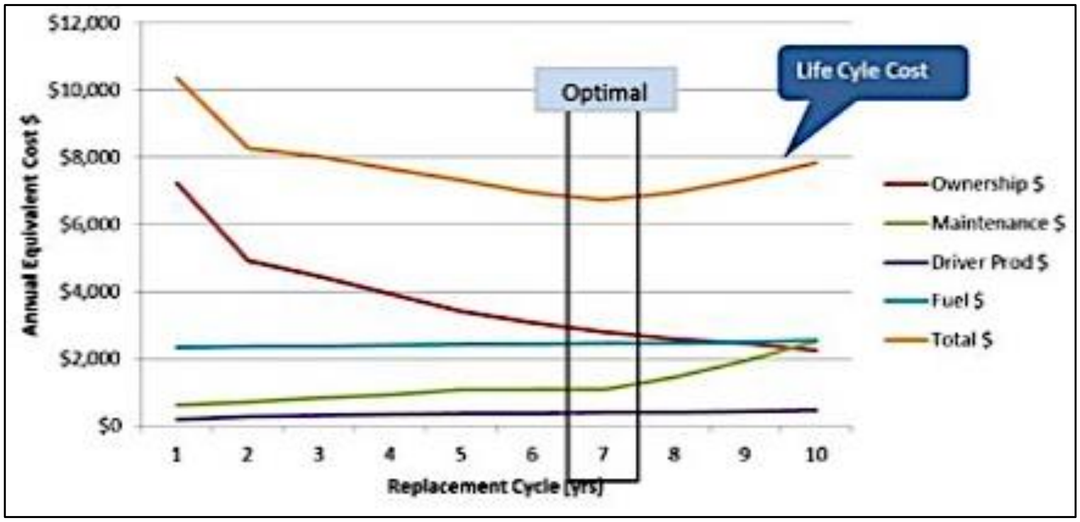

Figure 6. LCA Example

Step 5: Predictive Data-Modelling

Having established the fleet baselines and completed LCAs, data modeling was accomplished to assess the potential impacts of various go-forward solutions. The focus was on exploring financial outcomes, such as operating expenses (OPEX) and capital expenses (CAPEX), associated with different scenarios, including extended vehicle lifecycles. Each option carries multiple implications in terms of expenses and uptime.

Using the FAR software, calculations and predictions were generated for the Town in order to provide recommendations for decision-making. The data modeling focused on assessing the financial viability of each solution, with LCA-extended lifecycles playing a crucial role in planning fleet replacements by fiscal years. Once optimal economic lifecycles were determined for each vehicle type[11], the timing for unit replacements was established. As mentioned, extensive benchmarks, assumptions backed by referenced research, and policy research were employed to bridge any data gaps, ensuring that the recommendations are rooted in industry best practices regarding strategies and policies for replacement cycles.

This approach ensured a capital replacement plan that would maximize the value of current vehicles while providing an organized, structured strategy for replacements avoiding year-over-year spikes in capital budgets. The priority for replacements were units assessed as optimal candidates to deliver the best Return on Investment (ROI), typically those with higher utilization and fuel consumption. This strategic approach aims to enhance the overall efficiency and fiscal responsibility of the Town's fleet management.

Step 6: Long-Term Capital Planning

Building upon the extended lifecycles derived from the LCA review in Step 4, coupled with fleet management’s considerations, best practices regarding lifecycle policies and findings from the management practices questionnaire, recommendations were formulated for long-term capital budget vehicle replacement planning. These recommendations prioritize optimal ROI unit-by-unit, emphasizing low-carbon options to align with green fleet planning.

[11] Life Cycle Analysis (LCA) was conducted for vehicle categories with substantial data (more than 4 vehicles of a certain class) to ensure sufficient information for in-depth analyses.

A) Short, Mid, and Long-Term Fleet Planning

Utilizing 2023 historical data from the Town's fleet operations, a comprehensive evaluation long-term (15 years) planning was conducted. The recommendations for the Town's fleet review were developed, drawing from a comprehensive analysis of the provided data and shared fleet operating processes and practices. The primary focus was on achieving a balance between cost containment and reduction, with the goal of providing strategic insights into the impacts on both capital investment and ongoing operating expenses.

B) Gap Analysis

The FAR software tool facilitated the exploration of "what-if" scenarios. For instance, in the realm of green fleet planning, alternatives of replacing all vehicles with Battery Electric Vehicles (BEVs) were modeled for the Town's consideration.

Inputs and Assumptions

The primary dataset, the FAR input form, is a conglomeration of multiple sources of data submitted by the Town of Wasaga Beach and encompasses comprehensive data from the year 2023. Solely depending on data from a single year introduces inherent limitations, possibly obscuring exceptionally high costs not fully captured within this limited timeframe. The absence of historical data can further hinder a comprehensive examination of trends and patterns over time. To mitigate these constraints, supplementary insights and benchmarks from comparable municipalities were integrated, enriching the comprehensiveness of the overall analysis. Additional inputs and assumptions are detailed in the "Guide to FAR" tab within each Excel FAR model.

Other important assumptions that have been made when the information was not available include:

- *In instances where vehicle replacement costs were not provided, a replacement cost of a unit with the same make and model in the fleet was used. When there was no similar units in the fleet, the repurchase price was found on the OEM website, CarGurus' MSRP lookup webpage[12], auto dealer websites, or news articles stating the vehicle price. In the rare instance where this did not yield results, the replacement cost was found using another municipality's stated replacement cost of the vehicle. If the original purchase price was stated but no repurchase price was found, the repurchase price was calculated by assuming the price of the vehicle increased proportional to the inflation rate.*
- *When the original purchase prices was not provided, models with similar make, model, and purchase year that had original purchase prices were referenced. The online sources used to find replacement costs were used to find original purchase prices when they contained information on past prices. When this did not yield results, the original purchase price was calculated by using the repurchase price and reducing the price by inflation to the original purchase price year.*
- *To compute the salvage cost of the vehicle or equipment, 10% of the original purchase price was used.*
- *Duration of vehicle usage equated to its model year, unless specified.*
- *To determine the fuel consumption in liters, the total fuel cost was divided by the average prevailing unit cost of $1.65 per liter for diesel and $1.45 for gasoline. This was determined using fuel prices in the Town of Wasaga Beach as of February 1, 2024.*

[12] Source: https://www.cargurus.com/research

- *An internal labour rate of $54.90 per hour was applied for maintenance services. This was determined by using the Town's full-time wages for mechanics. 32.3% of the labour rate is for employee benefits, E.I., CPP, OMERS, and other related expenditures.*
- *For missing information (e.g. blank planned lifecycles), similar class and type of vehicle was used as a reference.*

Understanding the Town's Baseline

This section of the report delves into the quantitative aspects of the Town of Wasaga Beach's fleet, comparing the current state of the fleet with similar municipalities. The exploration extends to the impact on capital and operational expenditures as well as greenhouse gas (GHG) emissions. The intention is to unveil potential areas for improvement in long-term planning and transitioning to lower emitting vehicles to significantly enhance operational efficiency, reduce costs, and lower GHG emissions.

Fleet Makeup

For the baseline review, there were 173 in-scope fleet vehicles and equipment[13]. All units were owned during the 2023 review period or purchased in January of 2024.

Table 3. Town of Wasaga Beach Fleet Makeup in 2023

Type[14]	Count
Class 1 – SUV	11
Class 1 – Pickup	1
Class 1 – Van	3
Class 2 – Van	2
Class 2 – Pickup	47
Class 2 - Bus	1
Class 3 – Pickup	5
Class 4 - Bus	4
Class 5 – Truck	3
Class 6 – Truck	7
Class 7 - Truck	4
Class 8 - Truck	21
Mobile Equipment	40
Trailer	26
Total Units	**173**

The Town's current method of only owning vehicles, rather than renting or leasing, aligns with our comparative assessment of each option via discounted cash flow (DCF) models, completed in Appendix D. The analysis serves as an illustrative example of the costs that should be taken into consideration when purchasing, leasing or renting. It is based on a particular municipality in 2021 that had recently received competitive quotes from various rental companies for a sedan, and aims to provide a practical demonstration of the key considerations involved in such an analysis.

To complete the analysis of purchasing, leasing, and renting, several business assumptions were required. The analysis and comparisons were based on the three cases (purchasing, leasing, or renting)

[13] Power tools and a 1946 firetruck were removed from the analysis. The power tools were removed due to a lack of data collection on a per tool basis, making tool-specific recommendation impractical. The firetruck was removed from the analysis due to it being used primarily for parades and having no planned time of replacement.
[14] Please see Appendix F for more information on weight classifications.

around one vehicle-type (class 1 sedan). This vehicle-type was used since it is a common vehicle-type with comparable expenses to other light-duty vehicles. Furthermore, to obtain accurate data for rental rates and contractual conditions, information from a recent municipal client was utilized. This particular municipality had recently received competitive quotes from various rental companies for a similar sedan (2021).

After completing the DCF model for owning, leasing, and renting cases, the model showed that owning would provide the lowest total cost of ownership (TCO) over a 12-year lifecycle (the recommended lifecycle for class 2 pickups). It is worth noting that the Town currently considers adding light-duty vehicles to the surplus pool after year 7, in which they may stay for several more years depending on the vehicle condition. This analysis directly reflects the recommended 12-year lifecycle, and provides an approximation of which option would be best if current replacement schedules are kept. Table 4 summarizes the analysis. Based on the modelling, purchasing a vehicle resulted in the lowest cost of ownership. The highest cost of ownership was found in the case with two consecutive 6-year leases.

Table 4. Summary of Purchase, Lease & Rent Analysis

Purchase – Lifecycle TCO	Lease w/ purchase	Rent	Lease 6-years x 2
$86,257	$89,690	$103,838	$118,350

Similar results are expected for all Town of Wasaga fleet vehicles. For this reason, it is recommended that the Town continues to purchase vehicles, rather than leasing or renting.

Town of Wasaga Beach's Fleet Statistical Baseline

This report is based on the detailed data analysis of one-year of historical data as submitted by the Town[15]. High-level, fleet-wide statistics from the one-year baseline review period (2023) are listed in Table 5.

Table 5. Summary Statistics - Town of Wasaga Beach (snapshot from 2023)

Summary Statistics – Town of Wasaga Beach	Statistic
Number of Operations fleet vehicle and equipment units	173
Total vehicle kilometres travelled in 2023 (VKT)	1.4M
Original purchase price for the fleet	$19.4M
Current-day replacement cost[15] (like-for-like replacements)	$27.0M
Current book (depreciated) value	$11.8M
Salvage value at end of lifecycle	$1.9M
Cost of capital[16]	$596K
Cost of preventive maintenance (PM)	$141K
Cost of reactive repairs	$1.3M
Cost of fuel	$691K
Fuel used (L)	451K
Rental costs[17] (e.g., short-term rental units)	$0
Downtime cost (for the full review period)[18]	$199K

[15] Where data was not available, with the approval of the Town, online research or comparable fleet data was used.
[16] For FAR data modeling, the cost of capital is treated as an operating expense.
[17] During the review period no rental units were reported to be in the active fleet.
[18] The average cost related to unplanned downtime is estimated at $100/day for class 1, $200/day for class 2, $300/day for class 3, $400/day for class 4, $500/day for class 5, $600/day for class 6, $700/day for class 7, $800/day for class 8, and $100/day for mobile equipment and trailers. These standardized estimates were consistently applied across various projects for uniform assessment. It's worth noting that these figures can be updated in the FAR model (tab "Assumptions").

Total of controllable operating costs[19], including repairs and maintenance, fuel, cost of capital, and downtime	$1.8M
Downtime (days)	453
Tailpipe GHG emissions (tailpipe combustible, metric tons CO_2e)	1143
Corporate average fuel consumption (on-road units) (L/100 km)	31.8

Municipal Peer Fleet Comparisons

Comparative Analysis of Average Statistical Data:

The average statistical data for the Town of Wasaga Beach was compared to a group of 24 municipal fleets, which were selected from Deloitte's database for comparison purposes. 24 municipal peer fleets with similarities to the Town of Wasaga Beach fleet as far as their service area (e.g., urban, or rural), location (e.g., fleets with climatic and geographical characteristics relatively similar to Wasaga Beach) and fleet mix (e.g., the types and numbers of units that made up the peer fleets) were selected.

Table 6. Municipal Peer Fleet Comparisons

Key Performance Indicator (KPI)	Description	Metric	Town of Wasaga Beach	Benchmark Data – Average of 24 Canadian Municipal Fleets[20]
Population (2021)	Town of Wasaga Beach	Person	24,862	-
Area	Town of Wasaga Beach	Km^2	57.42	-
Vehicles in Review	On-Road Vehicles	No. of Units	107	12,178
Units in Review	Mobile Equipment, Ancillary Equipment, and Attached Equipment	No. of Units	66	-
Average Age	Total Fleet (on-road units only)	Years	6.9	5.6
Average Age	Light Duty (Car, Pickup, Van, SUV) (Class 1, 2)	Years	6.0	4.6
Average Age	Medium Duty Trucks (Class 3, 4, 5)	Years	3.0	6.6
Average Age	Heavy-Duty Trucks (Class 7, 8)	Years	10.0	7.4
Average Age	Mobile Equipment	Years	10.8	-
Average Vehicle Kilometers Travelled (VKT)	Total Fleet (on-road units only)	Kilometers	13,152	14,889
Average Vehicle Kilometers Travelled (VKT)	Light Duty (Car, Pickup, Van, SUV) (Class 1,2)	Kilometers	10,575	15,222
Average Vehicle Kilometers Travelled (VKT)	Medium Duty Trucks (Class 3, 4, 5)	Kilometers	45,588	13,022
Average Vehicle Kilometers Travelled (VKT)	Heavy-Duty Trucks (Class 7, 8)	Kilometers	8,907	10,799

[19] Controllable operating costs are those over which fleet management has direct control including fuel, maintenance, repairs, rentals/leases, cost of capital, and downtime.
[20] The 24 municipal fleets are a mix of urban and rural settings. They were selected as they had similarities to the Town of Wasaga Beach.

Corporate Average Fuel Economy (CAFE)	On-road units	L/100 KM	31.8	31.4
Average Downtime	On-road units	Days/vehicle	2.0	7.4
Average PM Cost	On-road units	$	$1,096	$1,897
Average Repair Cost	On-road units	$	$1,123[21]	$4,513
Average Forecasted Capital Cost Next Year	On-road units	$	$6,824[22]	$1,477
Average Fuel Cost	On-road units	$	$5,519	$4,471
Average Total Controllable Costs	On-road units	$	$11,882	$13,320
Cost per Kilometer	On-road units	$ per KM	$1.68	$1.95
Cost per Kilometer	Light Duty (Car, Pickup, Van, SUV)	$ per KM	$0.75	$0.62
Cost per Kilometer	Medium-Duty Trucks (Class 3, 4, 5)	$ per KM	$0.62	$1.83
Cost per Kilometer	Heavy-Duty Trucks (Class 7, 8)	$ per KM	$4.33	$3.41
Average Availability	On-road units	%	99.2	97.6
Average Vehicle GHG Intensity	On-road units	Avg. CO_2 kg/km	0.70	1.1
Maintenance Ratio	On-road units	% of total parts & labour	0.31	0.57
Next Year Capital Replacement Ratio	Vehicles & Equipment	Capital Required as % of NPV	43.8%[22]	35%
Area Ratio	Vehicles	Vehicle/KM2	1.9	1.1
Population Ratio	Vehicles	Residents/Vehicles	235	974

In comparison to the 24 Ontario peer fleets outlined in Table 6, the Town's fleet exhibited alignment with or surpassed key performance indicators in various areas. However, specific metrics revealed disparities, suggesting potential areas for improvement and targeted enhancement efforts.

Fleet Age:

- *The Town's fleet exhibits an older age of 6.7 years compared to the comparative average of 5.6 years (for on-road vehicles). This statistic could be interpreted as negative; however, utilizing assets longer most often results in a lower total cost of ownership. Knowing the optimal economic lifecycles of assets and planning capital budgets around this information is essential to getting the maximum return on investment (ROI) from each unit. As such, a Lifecycle Assessment (LCA) study was completed to calculate and recommend the optimal retention cycles for the Town.*

Vehicle Kilometers Travelled:

- *In comparison to the other municipalities, the average vehicle kilometers travelled (VKT) were lower for the Town's fleet across light-duty vehicles of class 1 & 2 (-31%) and heavy-duty (-18%), with a significantly higher than average for medium-duty vehicles (+250%), resulting in an overall*

[21] Low repair costs most likely due to having an in-house mechanic. Also, with only one mechanic in 2023, non-essential repairs may have been pushed to a future date.
[22] Impacted by COVID-19-related carryover of capital expenditure due to supply chain issues in the automotive sector between 2020 and 2023.

fleet average of -12%. Typically, a lower VKT is indicative of an under utilized fleet. Given Wasaga Beach is expected to grow in population rapidly over the next few decades, this metric is less of a concern, assuming the kilometers travelled per vehicle increases quicker than the number of units in the fleet.

Corporate Average Fuel Economy:

- *The slightly higher Corporate Average Fuel Economy (CAFE) value of 31.8L/100km compared to the 31.4 average for other fleets signals lower fuel efficiency and increased fuel consumption per unit of distance traveled. This difference may stem from short-distance travel resulting in frequent stopping. Higher rates of fuel usage may also indicate driver behaviours, such as excessive idling.*
- *To address this, optimizing route planning, exploring fuel-efficient technologies, and considering alternative fuels aligned with urban fleet management practices may contribute to improving fuel efficiency and reducing overall consumption.*

Maintenance:

- *In terms of total average maintenance costs, encompassing repairs and preventive maintenance, the Town's expenses are significantly lower than peer municipalities. This can be attributed to the lower costs the Town faces with maintenance and small repairs being completed in-house.*

Downtime:

- *The estimated downtime[23] for on-road vehicles is nearly half that of the benchmark comparisons, standing at an average of 2.0 days per vehicle as opposed to 7.4 days per vehicle.*
- *Downtime is calculated by considering repair costs and the internal labor rate, chosen for consistency across scenarios due to the varied aspects of downtime and differing municipal practices. This standardized approach aids in making comparisons and offers a comprehensive perspective on the overall impact of downtime on fleet operations.*
- *The calculations do not incorporate lead times for parts, and the Town does not currently track this information. This makes it difficult to estimate delays associated with purchasing new components. Moreover, it's acknowledged that the impact of COVID-19 on the supply chain may have affected lead times for certain parts, adding to the complexity of downtime estimations.*

Controllable Costs:

- *The average controllable costs are lower than the comparison ($11,882 vs $13,320) which can be attributed to a lower cost of downtime and lower repairs and maintenance costs. This is the case despite the Town's higher fuel costs and elevated cost of capital (due to ongoing carryover).*
- *A potential driver for lowering controllable costs is replacing vehicles with battery electric models due to lower fuel prices and a tendency to have lower maintenance costs given the fewer moving parts, regenerative braking, and no oil changes. Hybrid vehicles share some of these benefits as well. Reducing these controllable costs is crucial to enhancing overall cost efficiency and ensure financial sustainability.*

[23] Downtime days are calculated by dividing the total repair costs by two (considering that, from past experience, it has been observed that repair costs are almost evenly split between labor costs and material costs). The resulting value is then divided by the internal labor rate to determine downtime hours, which is further divided by 8 to obtain the number of downtime days.

Fuel Costs and Cost per Kilometer:

- *Average fuel costs are 23% higher than the comparative fleets; this is most likely a testament to the cost of fuel increasing dramatically and staying elevated over the past two years due to global conflicts affecting oil prices. Many of the comparable fleets' data were not impacted by this due to their baseline year being prior to the spike in prices.*
- *The cost per kilometer of medium-duty vehicles was 66% lower than the comparable fleets, likely due to the small sample size that contains high-mileage, low-maintenance 12–24 seater buses.*
- *The cost per km of the on-road units was $1.68, versus the comparable fleets' $1.95. Given the Town's light-duty and heavy-duty vehicles were more expensive per kilometer in relation to the benchmark, the lower cost per kilometer can be attributed to the medium-duty vehicles.*
- *Further investigation into these metrics may include implementing tracking mechanisms (such as with a Fleet Management Information System) to identify any specific outliers or exceptionally high costs. Additionally, exploring alternative strategies to manage and optimize costs for heavy-duty vehicles would be beneficial. This may include considering additional preventive maintenance measures, analyzing fuel efficiency, or evaluating the overall usage patterns of these vehicles to identify areas for improvement.*
- *Overall, a lower cost per kilometers can be a positive indicator, suggesting efficiency in managing operational costs. Lowering the cost per kilometer is often a goal for fleet managers as it contributes to financial savings and may reflect effective strategies in areas such as fuel efficiency, maintenance practices, and resource utilization.*

Fleet Availability:

- *The fleet achieved an average fleet availability of 99.2% (percentage of the time the vehicles are available for use), surpassing the average fleet availability of 97.6%. This calculation considers downtime days relative to the 260 operational days in a year. However, it is crucial to acknowledge that the availability may have been artificially high due to the Town only having one mechanic in 2023 (increasing to two in 2024).*

Current Emissions and GHG Intensity:

- *In the base year (2023), the Town of Wasaga Beach's GHG emissions was 1,143 MTCO2e.*
- *GHG intensity, or greenhouse gas intensity, refers to the amount of greenhouse gas emissions in kilograms per kilometer travelled, often tied to economic or operational activities. It is a measure used to evaluate the environmental impact of a entity relative to its output or performance.*
- *Demonstrating lower GHG intensity (0.70 CO_2 kg/km) compared to the average fleet's (1.1 CO_2 kg/km) shows an overall better emissions efficiency.*
- *By calculating GHG intensity, fleet management can identify opportunities to improve the environmental performance of their operations. This approach supports sustainability goals, guides decision-making for cleaner technologies, and contributes to overall climate action efforts.*

Capital Replacement Ratio:

- *The capital replacement ratio for the Town is 43.8%, signifying the proportion of the existing assets' book value in relation to the overall cost of replacing the entire fleet. This percentage is calculated as the current vehicle/equipment book value divided by the total cost of replacement, and is significantly larger than the peer group's 35% average. The greater ratio indicates that* *vehicles may be being replaced sooner than necessary. Ensuring a balance between maintaining existing assets and introducing new ones is in line with industry standards and best practices.*

Area and Population Ratios:

- *The area ratio provides valuable insights into the spatial coverage efficiency of the Town's fleet operations compared to its peers. The Town has 1.9 vehicles/km^2, versus 1.1 vehicles/km^2 in peer fleets. Understanding and optimizing the area ratio is crucial for enhancing operational effectiveness and resource utilization within the fleet. Implementing advanced routing systems and reallocating vehicles strategically will maximize service coverage.*
- *The population ratio, which is 235 residents/vehicle versus 974 residence/vehicle as the benchmark, indicates that more vehicles are being used to serve fewer residents than peer fleets. However, it is expected that the population of Wasaga Beach will grow rapidly, indicating that the Town is prepared by having a greater supply of vehicles in the fleet.*
- *A limitation of these metrics is a comparison in population density and the overall area of the peer groups relative to Wasaga Beach, which can impact the number of vehicles required in the fleet.*

Comparative Analysis of Lifecycles

To gain insights into industry standards and align recommendations with best practices, an analysis of peer fleets' replacement lifecycles was conducted, providing a comprehensive understanding of their current policies and strategies. The analysis of peer fleets for replacement lifecycles included a specific focus on 7 out of the 20 fleets from Ontario, Canada, and a total of 12 from Canada, with the remaining fleets located in the United States. This broader perspective offers valuable insights into diverse fleet management practices and aids in aligning recommendations with industry practices.

Table 7. Lifecycle Comparisons

Class	Type	The Town of Wasaga Beach's Current Replacement Cycle, not including the surplus pool (years)	Most Common Replacement Cycles from 20 Other Fleets (Canada & USA)[24]
Light-Duty	Cars	**7**	**7-10**
	Pickups		**7-10**
	Vans		**7-10**
	SUVs		**7-10**
	Class 3 Trucks		**8-12**
Heavy-Duty	Class 8 Trucks	**11**	**10-15**
Equipment	-	**10**	**10-20**
Trailers	-	**13**	**10-15**
Fire	Fire Trucks	**13**[25]	**20**
	Fire Light-Duty Vehicles	**7**[25]	**8-10**

Examining Table 7, the Town currently follows lifecycles that are on the lower side for all vehicles compared to peer fleets. This is a comparison of lifecycle policy, as the Town does have a surplus pool that extends the life of some vehicles. Notably, the lifecycle of fire trucks is significantly less than industry averages and are slightly on the lower side when considering light-duty vehicles. Upon completion of the Lifecycle Assessment, these additional policies and benchmarks will serve as valuable references to ensure alignment with industry practices and standards.

[24] The information presented in this table represents an average range derived from the "Vehicle Lifecycle Policies Best Practices" document. The range was constructed using the most prevalent replacement lifecycles, omitting exceedingly low and high values for a more realistic assessment.

[25] Estimated useful life based on the Town's Tangible Capital Asset Management Policy (By-Law 2022-71 - Schedule A); however, the Fire Department has historically replaced light-duty fire trucks every 12 years, pumper trucks every 15 years, rescue trucks every 20 years, and aerial trucks every 25 years.

Business-as-Usual Modelling

Business-as-usual (BAU) modelling forecasts annual CAPEX, OPEX, and GHG emissions assuming the Town of Wasaga Beach continued with their current replacement schedule and repurchased the same fuel-type vehicles that are currently owned. The Town's 2023 CAPEX, OPEX, and emissions were calculated as the baseline, with the next 15-years being forecasted assuming annual mileage continued at the same rate.

Figure 7 shows the estimated amount of capital required for vehicle and equipment replacement, beginning in 2024. Many units are due or past due for replacements based on management's current replacement cycles which would require a major capital expense (CAPEX) investment of $8.9M. This is due to supply chain constraints that have impacted the automotive sector since 2020, resulting in delivery delays sometimes exceeding two years for the Town.

A best practice or guideline that is recommended is replacing vehicles at the depreciation rate. This means funding replacements as existing vehicles are wearing out. For example, if a fleet had a replacement value of $10 million and its average, fully depreciated lifecycle was ten years, then $1 million a year would be required to replace units at the depreciation rate, thus maintaining the fleet's average age. This assumes the fleet's current average age is at an acceptable level and performing satisfactorily in terms of uptime. If it is not then a temporary surge (e.g., increase) in CAPEX spending may be needed to replace the overly aged units that are reducing the fleet availability rate. This is a methodology that should not only be implemented for the entire fleet but also for each vehicle-type.

The replacement value of the Town's fleet was estimated to be approximately $27.0M. Over the 15-year time period, the average annual capital expenditure is $2.2M. Based on fleet management's current replacement schedules, $8.9M worth of vehicles are due for replacement, which is approximately quadruple the average expenditure per year; this emphasizes the need to rebalance forecasted CAPEX to pre-pandemic levels.

In Figure 7, the annual CAPEX is unbalanced with multiple year-over-year capital spikes over the next 15 years which is not desirable. Fleet managers and finance departments should strive for long-term CAPEX budgets balanced year-over-year, allowing for annual inflationary increases.

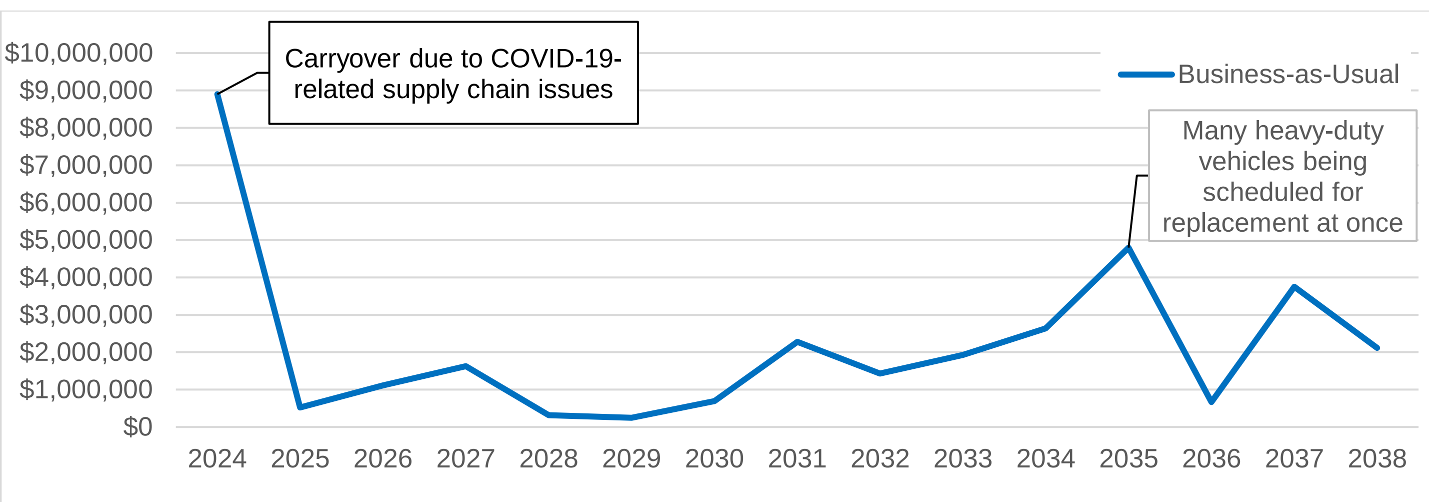

Figure 7. 15-Year CAPEX with Business-as-Usual Lifecycles

Despite the need for many replacements according to the current vehicle lifecycles, replacing under-utilized end-of-lifecycle units will not deliver a return on investment (ROI) because the cost of capital to purchase new vehicles would exceed the potential fuel and repair cost savings that would be gained. It is also worth noting, that an inflation rate of 2% also increases OPEX over time, not just fluctuations in cost of capital, fuel, and repairs and maintenance costs. In the Business-as-Usual Model, the average annual OPEX is $2.95M. The business-as-usual forecasted change in OPEX is illustrated in Figure 8.

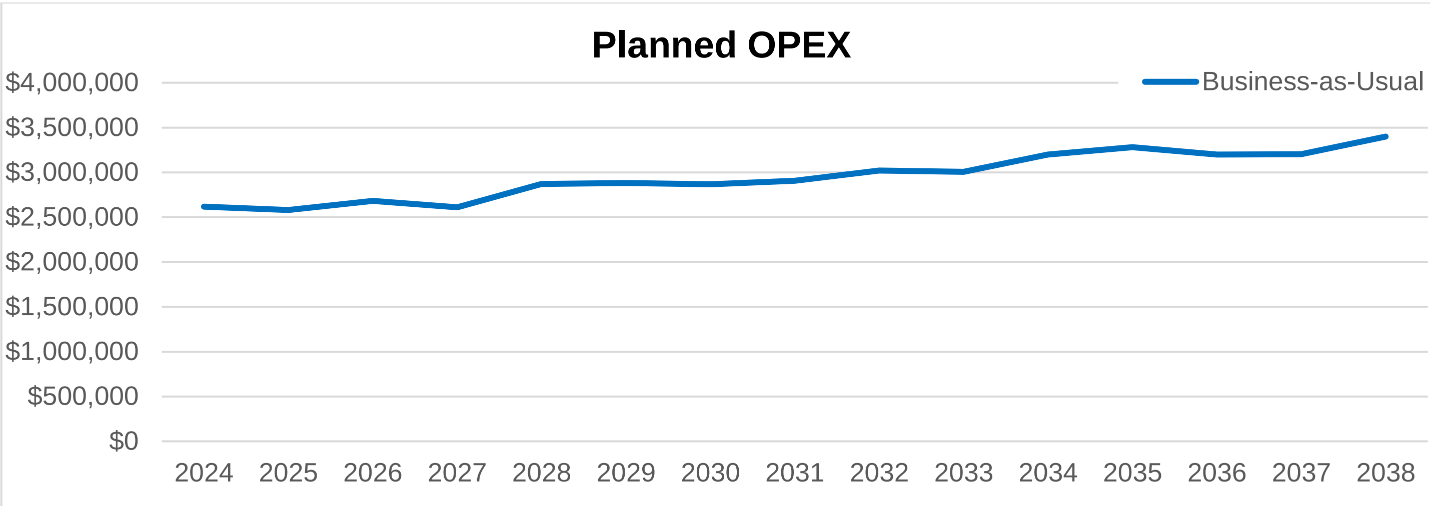

Figure 8. 15-Year OPEX with Business-as-Usual Lifecycles

The FAR model utilized in forecasting the Business-as-Usual outcomes accounts for improved fuel efficiencies in newer vehicles. As such, replacing ICE vehicles and lowering the average age of the fleet results in slight decreases in expected tail-pipe emissions. This is illustrated in **Figure 9**, especially in 2024 when a large portion of the replacements are planned.

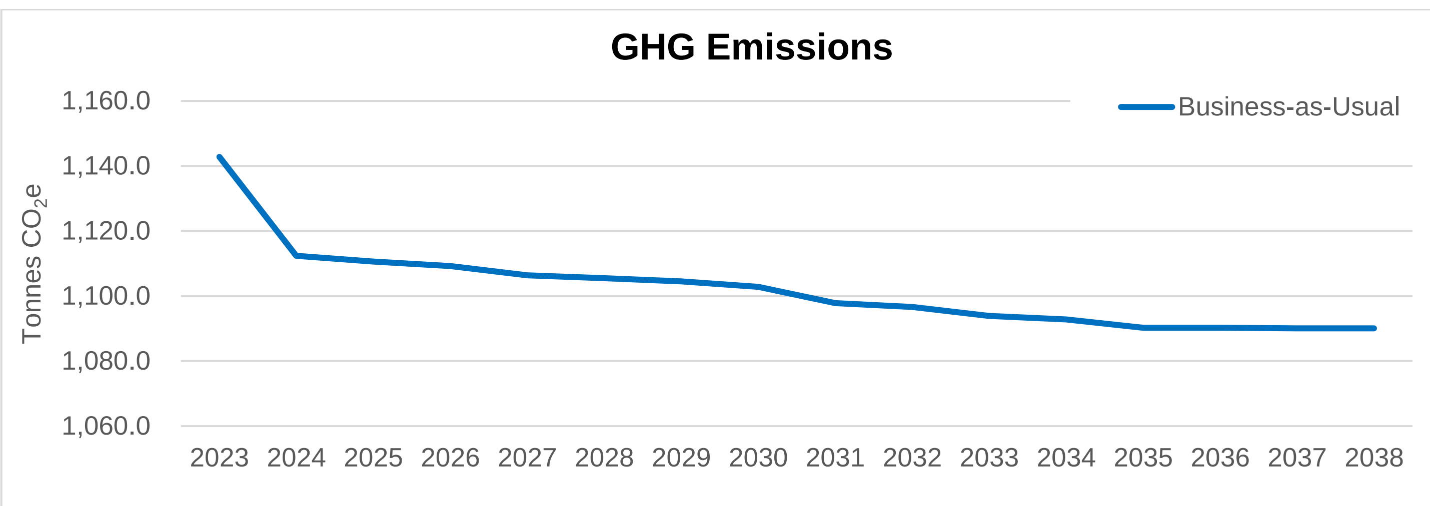

Figure 9. 15-Year GHG Emissions with Business-as-Usual Lifecycles

Below are highlights of the Baseline-as-Usual Model and their impacts:

- *The Business-as-Usual Model is the baseline that the following data models were compared to. It demonstrates the CAPEX, OPEX, and tail-pipe emissions that would occur given no changes to the Town's current vehicle replacement schedules.*

- *In Figure 8, the long-term 15-year CAPEX that would result from business-as-usual replacement practices is presented. The large CAPEX "spike" in 2024, represents vehicles that are now at or past the current replacement age. CAPEX is expected to gradually increase after 2030, and again as the planned replacements in 2024 come to the end of their lifecycle.*
- *In Figure 8, the OPEX gradually increases over time. Despite the expected decreases in fuel costs, maintenance, and repairs, the OPEX is still trending upwards due to inflation and increasing cost of capital that is associated with a newer fleet.*
- *In Figure 9, the GHG emissions gradually decreases over time due to a newer fleet with greater fuel efficiency. The change from 2023 to 2038 is only a 4.6% reduction in emissions, with a large portion of it occurring in 2024 with the "spike" in replacement vehicles.*

Extended Lifecycle Modelling

Optimizing the lifecycles of different vehicle and equipment-types have the potential to balance the CAPEX budget. If replacement schedules are too short, then either the Town will spend an excess amount on replacement vehicles, or delay purchasing, which results in current lifecycles being extended.

Lifecycle Assessment (LCA)

As an integral component of fleet review processes, a comprehensive Lifecycle Assessment (LCA) was conducted for major fleet vehicle categories to find the optimal life of the vehicle-types based on cost of ownership forecasts.

Given recent announcements by major auto and truck manufacturers to cease production of internal combustion engine (ICE) vehicles by 2035[26], and the Government of Canada's mandate that all light-duty vehicles must be zero-emission vehicles by 2035, the necessity of evaluating economic lifecycles for all vehicle types becomes paramount. Municipal fleet vehicles, often with lifecycles extending ten years or more, confront challenges related to the potential obsolescence of technologies and components as the market transitions towards Electric Vehicles (EVs). Recognizing this industry shift, the LCA process and tools illustrate the total lifecycle cost of owning and operating each fleet vehicle type for the Town.

Considering historical cost data, the LCA provides insights into when units should be considered for replacement. For enhanced precision and thorough analysis, previous project benchmarks for maintenance costs were employed to address data gaps and obtain a comprehensive understanding of costs throughout a vehicle's lifetime. Additionally, to stay aligned with industry best practices, a research study was conducted to gain insights into the strategies and policies employed by other municipalities. These findings were important in formulating recommendations that align with current industry standards.

It is essential to note that, as shown in Figure 10 below, the optimal replacement of vehicles should occur before costs escalate, reliability/safety is compromised, and capital expenditure or refurbishment becomes necessary. This strategic approach aligns with the commitment to maximizing operational efficiency. More information about LCA can be found in Appendix A.

[26] Source: https://www.forbes.com/wheels/news/automaker-ev-plans/

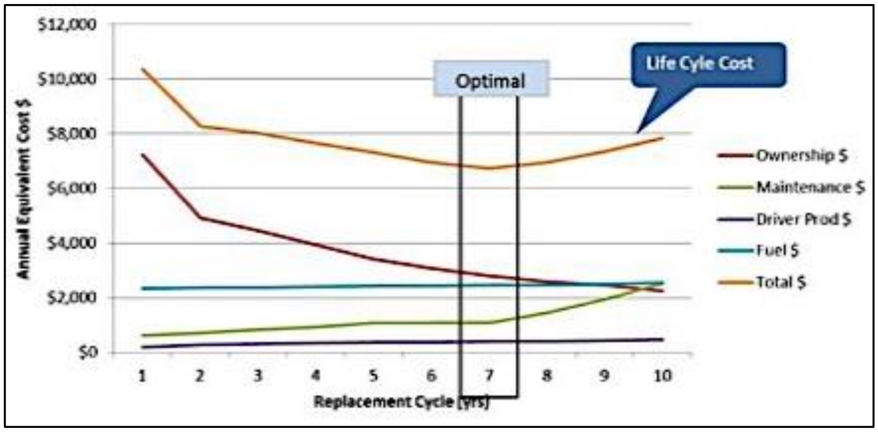

Figure 10. LCA Example

The LCA took into consideration the cost of downtime (as caused by reduced reliability), the year-to-year "rollup" of the cost of capital, inflation, worker cost/hour, salvage and market values, inflation, and average kilometres-driven data. The results are summarized in Table 8.

Table 8. Lifecycle Assessment by Class/Type

Class	Type	Current Replacement Cycle, not including the surplus pool (years)	Lower LCA Extended Lifecycle (years)	Upper LCA Extended Lifecycle (years)	Change (+ or – years)
2	Pickup	**7**	**11**	**13**	**+4 to +6**
1	SUV	**7**	**10**	**14**	**+3 to +7**
6-8	Firetruck	**13**[27]	**17**	**18**	**+4 to +5**
8	Truck (not including firetrucks)	**11**	**14**	**15**	**+3 to +4**

For the four major vehicle-types assessed, the lower end of the LCA extended lifecycles were chosen. When deciding how long the lifecycle of each vehicle-type should be within the range, several factors were considered. This includes comparable Canadian and US fleet lifecycles (Table 7) and concerns regarding firetruck conditions found in the survey (Appendix B). It is unclear if the concerns about the firetrucks condition stem from only the 22-year-old firetruck (Pumper #3), but the lower end was used to be conservative. It is recommended that conditions of vehicles are logged and updated annually. For higher annual mileage vehicles in the fleet, it is recommended that the Town reviews the condition of these vehicles at thresholds of 20,000 km/year for light-duty vehicles (LDVs) and 25,000 km/year for medium- and heavy-duty vehicles (MHDVs) for potential early replacement.

These updated lifecycles were inputted into the Fleet Analytics Review (FAR) model and used to create a Lifecycle Extended Model.

Inputting the Extended Lifecycles into the Model

Starting from the Business-as-Usual Model, the vehicle replacement thresholds were updated to evaluate the impacts using extended lifecycles based on the lower range from the LCA (see Figure 11).

[27] Estimated useful life based on the Town's Tangible Capital Asset Management Policy (By-Law 2022-71 - Schedule A); however, the Fire Department has historically replaced pumper trucks every 15 years, rescue trucks every 20 years, and aerial trucks every 25 years.

Optimizing lifecycles to maximize the value extracted from a vehicle is a fundamental aspect of effective fleet management, ensuring a better return on investment.

Optimizing vehicle lifecycles is a strategic approach in fleet management aimed at achieving an optimal balance between operational efficiency and cost-effectiveness. This involves conducting thorough analysis of each vehicle's lifecycle, monitoring utilization, adopting proactive maintenance strategies, considering technological upgrades, evaluating fuel efficiency, and factoring in resale value. The total cost of ownership, environmental impact, regulatory compliance, and a continuous improvement mindset play integral roles in making informed decisions throughout the lifecycle of each vehicle. For further insights and detailed recommendations, additional information can be found in Appendix A.

Over the 15-year time period, the average annual capital expenditure of the Lifecycle Extended Model is $1.73M, representing a reduction in average annual capital expenditure of $0.47M. Based on the updated replacement schedules, $5.6M worth of vehicles are due for replacement. This elevated CAPEX is still due to supply chain issues within the automotive sector that impacted the Town for several years. Although this is an improvement from the current replacement schedule, the model still has a large implied variance in CAPEX, as shown in Figure 11.

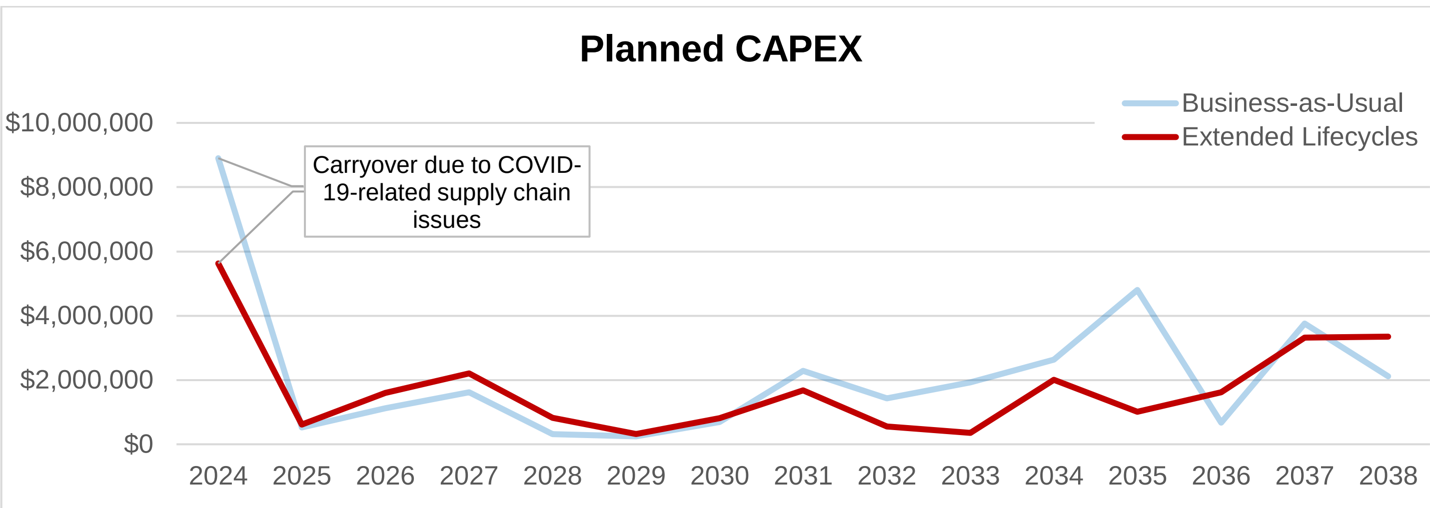

Figure 11. CAPEX of the Lifecycle Extended Model in relation to the Business-as-Usual CAPEX

In the Business-as-Usual Model, the average annual OPEX is $2.95M, while with the updated lifecycles, the average annual OPEX increases to $3.26M. The Updated Lifecycle Model's forecasted OPEX is illustrated in Figure 12.

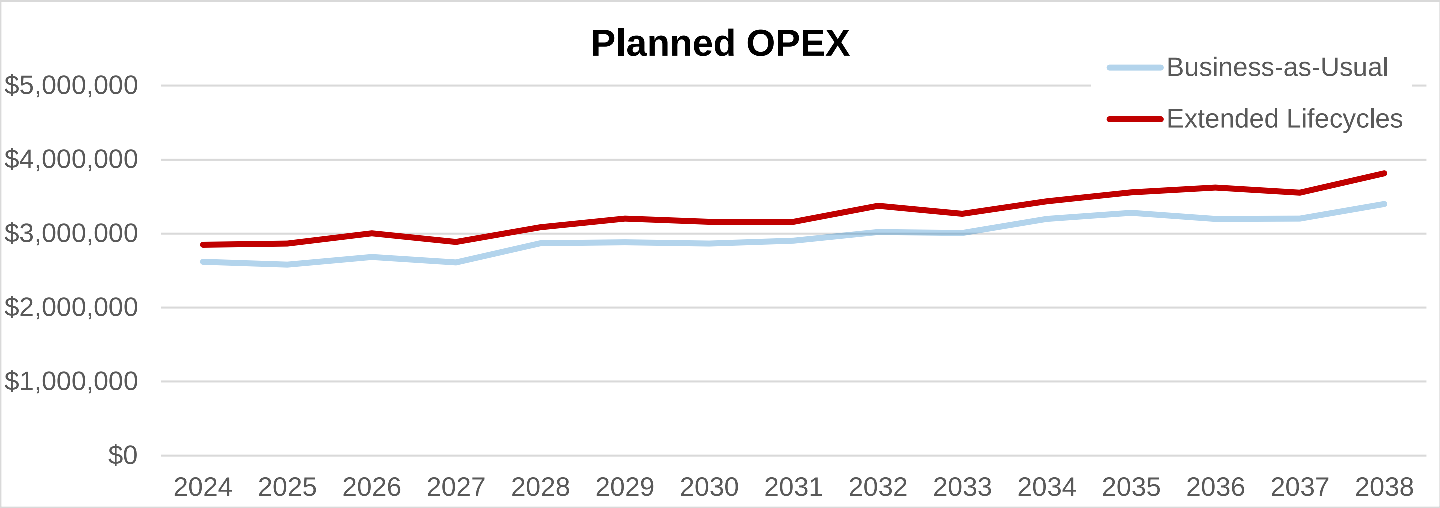

Figure 12. OPEX of the Lifecycle Extended Model in relation to the Business-as-Usual OPEX

The FAR model utilized in forecasting the modelled outcomes accounts for improved fuel efficiencies in newer vehicles. As such, increasing the lifecycles slightly increases tail-pipe emissions. This is illustrated in Figure 13.

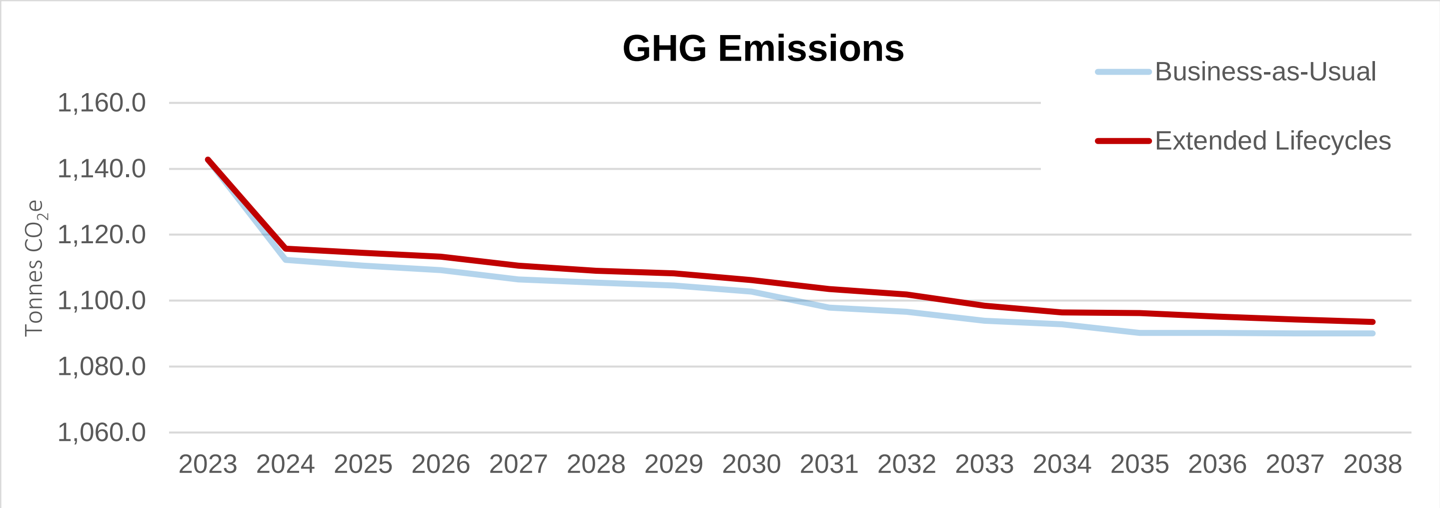

Figure 13. Emissions of the Lifecycle Extended Model in relation to the Business-as-Usual emissions

Below are highlights of the Extended Lifecycle Model and the impacts of implementing the increased lifecycles:

- *Over the 15-year time period, the average annual capital expenditure of the Extended Lifecycle Model is $1.73M, representing a reduction in average annual capital expenditure of $0.47M. Based on the updated replacement schedules, $5.6M worth of vehicles are due for replacement in 2024.*
- *In the BAU Model, the average annual OPEX is $2.95M, while with the extended lifecycles, the average annual OPEX increases to $3.26M. This represents an increase in OPEX of $0.31M due to an increase in maintenance requirements for older vehicles.*

- *The average annual cost savings, based on the summation of CAPEX and OPEX, is approximately $160,000 per year.*
- *In Figure 13, the tail-pipe GHG emissions gradually decreases similarly to the BAU Model.*
- *The Extended Lifecycles Model has an average annual emissions that is 0.4% greater than the Business-as-Usual Model.*

Manually Balanced Capital Budget Modelling

Starting from the Business-as-Usual (BAU) Model, the vehicle replacement thresholds were updated to evaluate the impacts using extended lifecycles based on the lower range from the LCA (see Figure 11). In this section, manual adjustments to the replacement schedule of some vehicles and mobile equipment units were made to balance the forecasted capital expenses. Replacement adjustments were based on two factors, the condition rating of the vehicle, and the estimated ROI if the vehicle is replaced. In cases of small or negative ROI, unit replacements are deferred to balance long-term capital expenditures.

Achieving optimal value for each fleet asset involves the strategic application of optimized economic lifecycles and total cost of ownership methodologies. Integrating these approaches with thorough digital vehicle condition evaluation sheets harmonizes long-term capital expenditures annually, aligning with depreciation rates and ensuring optimal unit-by-unit return on investment.

The result of these further lifecycle changes over the 15-year time period is an average annual capital expenditure of $1.46M. This represents average annual CAPEX savings of $0.74M relative to the BAU Model and $0.26M relative to the Extended Lifecycle Model. The variance in the CAPEX was also reduced drastically, as shown in Figure 14.

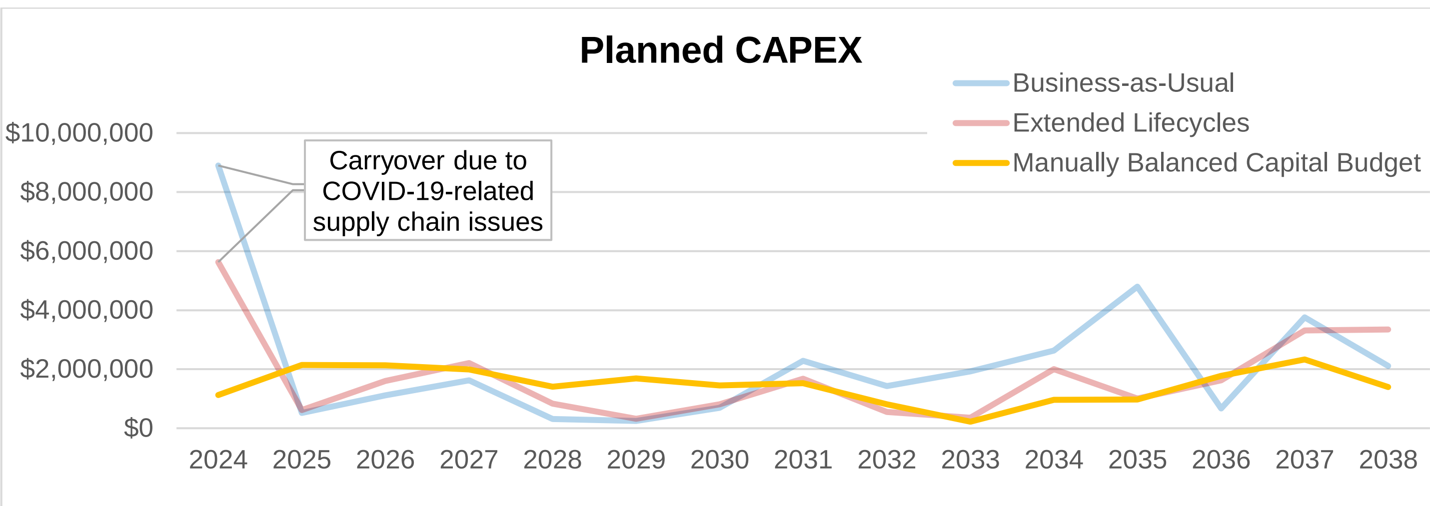

Figure 14. CAPEX of the Manually Balanced Capital Budget Model relative to the previous models

In the BAU Model, the average annual OPEX is $2.95M, while with the updated lifecycles, the average annual OPEX increases to $3.26M. The third model, which contains manual adjustments to lifecycles, forecasts the average annual OPEX to be $3.31M, which represents a slight increase relative to the Extended Lifecycle Model. As expected, the BAU Model consistently has the lowest OPEX. This is due to the impact of extending the lifecycle of vehicles, which results in slight increases in repairs and maintenance, as illustrated in Figure 15.

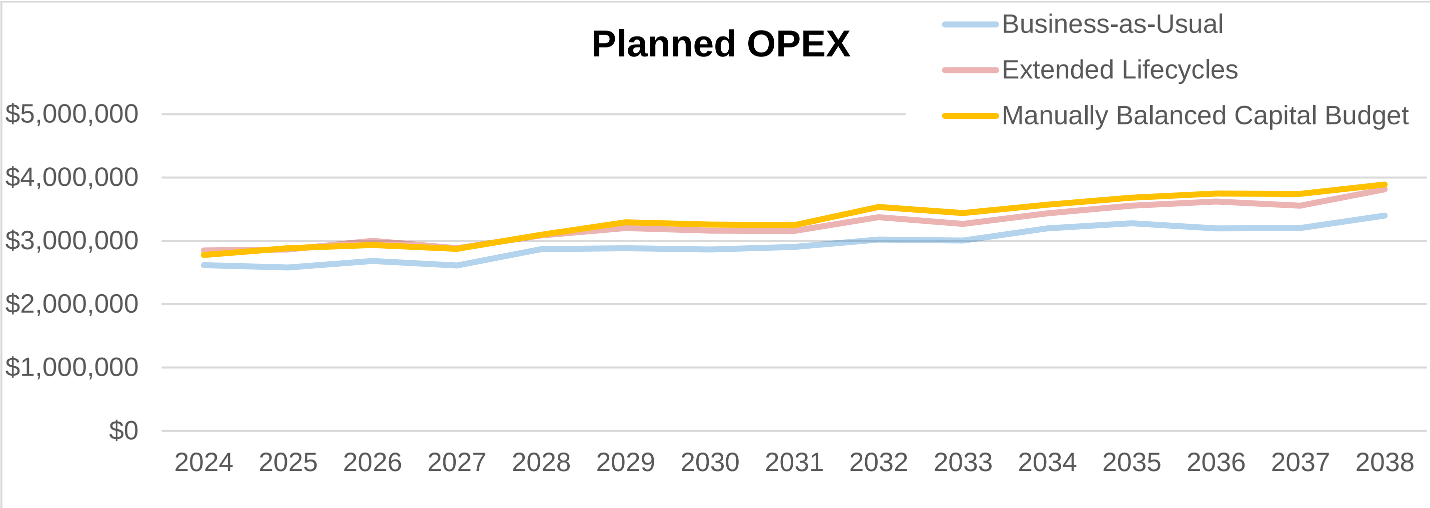

Figure 15. OPEX of the Manually Balanced Capital Budget Model relative to the previous models

Manually adjusting the replacement schedule of some units yielded negligible differences in emissions forecasts. This is illustrated in Figure 16.

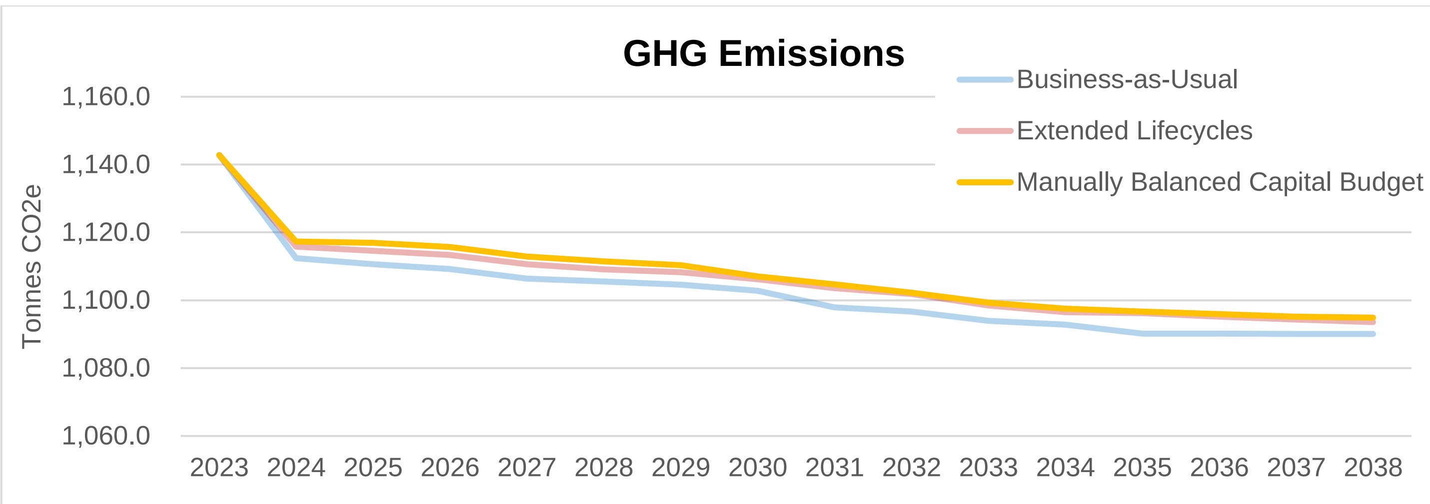

Figure 16. GHG emissions of the Manually Balanced Capital Budget Model relative to the previous models

Below are highlights of the Manually Balanced Capital Budget Model and the impacts of implementing the increased lifecycles:

- *Over the 15-year time period, the average annual capital expenditure of the Manually Adjusted Lifecycle Model is $1.46M.This represents average annual CAPEX savings of $0.74M relative to the BAU Model and $0.26M relative to the Extended Lifecycle Model.*
- *Over the 15-year time period, the average annual OPEX of the Manually Balanced Capital Budget Model is $3.33M. This represents an increase of annual operating expenditure relative to the BAU Model of $0.38M and $0.08M relative to the Extended Lifecycle Model.*
- *The average annual cost savings, based on the summation of CAPEX and OPEX, is approximately $360,000 per year relative to the BAU Model.*
- *The average annual cost savings is approximately $180,000 per year relative to the Extended Lifecycle Model.*

Analyzing Vehicle Replacement Options

The Green Fleet Strategy builds off the Manually Balanced Lifecycle Model by adopting the same replacement schedule but exchanging the replacement vehicles of eligible diesel, gasoline, and propane vehicles with low-carbon alternatives.

The eligibility of a vehicle is dependent on several factors, beginning with the availability of a similar vehicle in Ontario. If the low-carbon replacement vehicle impedes the worker's capacity to do their job by reducing their access to a vehicle as it fuels up or charges, has lower towing capabilities than what is required, or has less cabin space than required, then it is ineligible to replace the current model in the fleet. Another factor that was considered was mileage. If the replacement vehicle does not have a large enough range to operate throughout the day, and it cannot be fueled up or charged quick enough at lunch, then it is an ineligible replacement vehicle.

Once the vehicles that fill these criteria are confirmed, the purchase costs, maintenance, fuel savings, emissions reductions, resale value, government incentives, fueling/infrastructure needs, and additional training requirements for maintenance and operations are analyzed.

To determine which low-carbon technology is most suitable for the Town's fleet, it's important to understand the technologies' applications, infrastructure requirements and availability, and which assets they are most suitable to replace.

Understanding Low-Carbon Fuel Options:

Of all current-day fuel-reduction solutions, fuel switching is often the most expedient way to reduce GHG emissions in the short term. As awareness of climate change issues amplify, the use of low-carbon fuels is gaining increased domestic and global interest. Fuel switching is a process of diverting a fleet's fuel consumption away from traditional fossil-based sources to either alternate or renewable energy sources. Figure 17**Figure 17** shows the carbon intensity of various fuels such as renewable natural gas (RNG), compressed natural gas (CNG), ethanol, and biodiesel, relative to traditional fossil fuels such as gasoline and diesel.

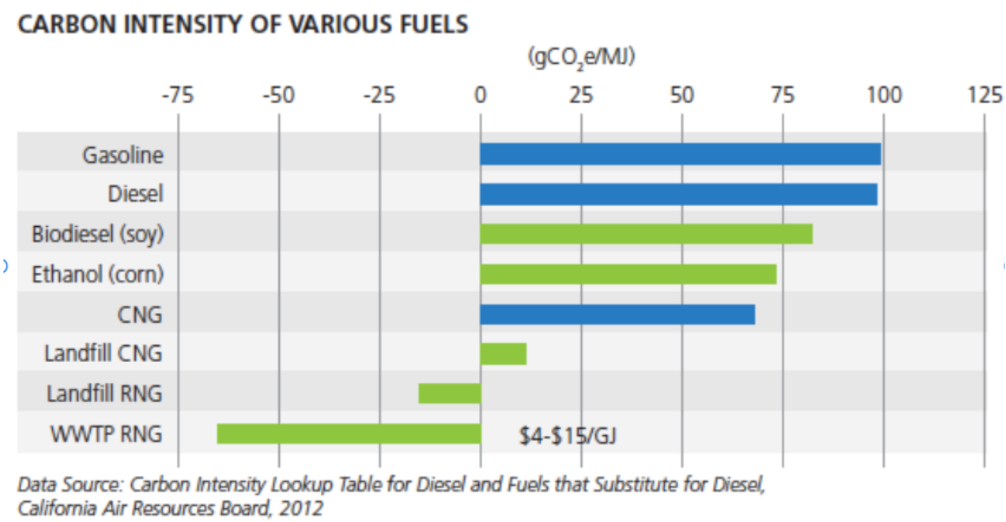

Figure 17. Carbon intensity of various fuels (where WWTP RNG is wastewater treatment plant RNG)

Regardless of which fuel-switching options are selected, the reality is that each will require some degree of effort to implement. For example, although trucks are capable of using biodiesel and/or renewable diesel, obtaining the fuels may bring new operational challenges such as switching bulk suppliers and/or requiring extra efforts from vehicle drivers to attend different retail fuel stations instead of those they are accustomed to frequenting. Adding B20 ("20" representing the percentage of biodiesel in the blend) and higher-blend biodiesel to the in-house fuelling supply system will require minor modifications, extra work routines, and procedures for staff to follow. Figure 18 provides an overview of all the low-carbon fuel alternatives currently available to reduce a fleet's fuel consumption and GHG emissions, while the sections below only go in-depth on the main fuels with proven emissions reduction potential or future cost savings.

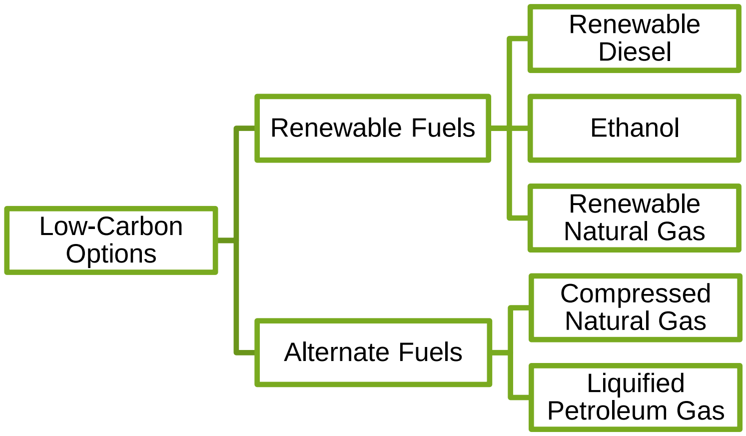

Figure 18. Low-Carbon Fuel Options

An alternative to using low carbon fuels to power an internal combustion engine is to introduce a new vehicle technology such as battery-electric or hydrogen fuel cell vehicles. Some jurisdictions have already legislated elimination of the sale of internal combustion engine vehicles in coming years, such as Norway in 2025[28] or California in 2035[29].

The two main renewable fuels to be considered, biodiesel and ethanol, as well as compressed natural gas (CNG) are described in detail below.

Biodiesel

Biodiesel is a renewable fuel made from vegetable oil and waste cooking oil, animal fats such as beef tallow and fish oil, and even algae oil. Biodiesel can be blended in a variety of ratios with conventional fossil diesel. Much of the world uses a system known as the "B" factor to state the amount of biodiesel in any fuel mix (e.g., B2 indicates 2% biodiesel and 98% fossil diesel)[30].

Canadian regulations require fuel producers and importers to have an average renewable fuel content of at least 2% based on the volume of diesel fuel and heating distillate oil that they produce or import into Canada. The regulations include provisions that govern the creation of compliance units, allow trading of these units among participants and also require record-keeping and reporting to ensure compliance[31]. Blends of 20% biodiesel or lower can be used in diesel equipment with minimal modifications, though some manufacturers may not extend warranty coverage for damage caused by the potential of poor-quality fuel in these blends. Blends higher than B20 are subject to gelling in cold conditions. Pure biodiesel (B100) may necessitate vehicle modifications to prevent maintenance and performance issues.

<u>Emissions Reduction Potential:</u> The reduction in tailpipe GHG emissions depends on the biodiesel blend, with higher blends offering greater reductions. For instance, B20 can decrease CO2 emissions by 15% compared to conventional diesel per unit mass/volume. However, the actual emissions reduction per distance traveled is influenced by both GHG emissions per unit mass/volume and fuel economy. B5 has

[28] Source: https://spectrum.ieee.org/ev-adoption-2030-goals
[29] Source: https://www.cnbc.com/2022/08/25/california-bans-the-sale-of-new-gas-powered-cars-by-2035.html
[30] Source: https://www3.epa.gov/region9/waste/biodiesel/questions.html
[31] Source: https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/renewable.html

been found to improve fuel economy by up to 10%, while fuel economy may be 2% lower for B20 and up to 10% lower for B100. This suggests an optimal range for both fuel economy and GHG emissions reduction lies in blends from B5 to approaching B20, providing approximately a 10% improvement in both fuel economy and GHG tailpipe emissions. Biodiesel use can also reduce other tailpipe emissions, such as particulates and unburned hydrocarbons, and result in lower lifecycle CO2 emissions compared to conventional diesel.

Ease of Implementation: There are no vehicle conversion or infrastructure costs associated with biodiesel use. Therefore, biodiesel could be immediately introduced without delay to begin reducing emissions for a fleet. It is important to use optimal blends dependent on operational needs and weather to ensure optimal performance and prevent engine wear.

Operational Considerations when Choosing Higher Biodiesel Blends: To minimize risk, a higher blend (B20 or higher, depending on the cloud point of a particular biodiesel) could be used in the warmest months of the year and B5 could be used during the rest of the year. Many Canadian and U.S. fleets using biodiesel follow this practice. To maximize the overall impact of the biodiesel's usefulness in reducing GHGs it is recommended that the highest possible biodiesel blend be used during the summer and shoulder Fall, Spring) months.

ASTM Standards: The American Society for Testing and Materials (ASTM) establishes standards for biodiesel, diesel, and heating oil. Four ASTM standards pertinent to consumer use of biodiesel and biodiesel blends are ASTM D6751, ASTM D975, ASTM D7467, and ASTM D6468. It is crucial to reference these standards before implementing biodiesel products.

Storage and Handling: Biodiesel fuels have shown poor oxidation stability, which can result in long-term storage problems. When biodiesel fuels are used at low ambient temperatures, filters may plug and the fuel in the tank may thicken to the point where it will not flow sufficiently for proper engine operation. Therefore, it may be prudent to store biodiesel fuel in a heated building or storage tank (typically costing over $1,500, depending on tank size[32]), as well as heat the fuel system's fuel lines, filters, and tanks. Additives also may be needed to improve storage conditions and allow for the use of biodiesel fuel in a wider range of ambient temperatures. Biodiesel fuel is an excellent medium for microbial growth. Since water accelerates microbial growth and is naturally more prevalent in biodiesel fuels than in petroleum-based diesel fuels, care must be taken to remove water from fuel tanks.

Cost: Although biodiesels such as B20 are slightly lower cost than conventional diesel per gasoline gallon equivalent[33], this is offset by the material energy losses per unit volume compared to diesel.

Health and Safety: Pure biodiesel fuels have been tested and found to be nontoxic in animal studies. Emissions from engines using biodiesel fuel have undergone health effects testing in accordance with EPA Tier II requirements for fuel and fuel additive registration. Tier II test results indicate no biologically significant short-term effects on the animals studied other than minor effects on lung tissue at high exposure levels. Biodiesel fuels are biodegradable, which may promote their use in applications where biodegradability is desired (e.g., marine or farm applications). Biodiesel is as safe in handling and storage as petroleum-based diesel fuel.

Given that biodiesel does not provide any substantive cost savings, the principal reasons to switch to biodiesel appear to be slight reductions in emissions and improved safety. Due to this lack of cost savings, biofuels were not recommended in the Green Fleet Strategy.

[32] Source: https://fuelsonline.ca/our-products/fuel-storage-tanks/
[33] Source: https://afdc.energy.gov/files/u/publication/alternative_fuel_price_report_july_2023.pdf

Ethanol

Ethanol is a renewable fuel made from various plant materials known as biomass or feedstocks. Corn and wheat are most commonly used to produce ethanol. In most North American jurisdictions, renewable fuel standards require all gasoline sold to be a 5-10% ethanol blend (E5-10). Ethanol burns cleaner and more completely than gasoline or diesel fuel; blending ethanol with gasoline increases oxygen content in the fuel, thereby reducing air pollution[34].

A higher blend of ethanol, known as E85 (85% ethanol, 15% gas), is available in some areas and can lead to significant GHG reductions. The 15% gasoline is needed to assist in engine starting because pure ethanol is difficult to ignite in cold weather[35]. This fuel must be used in dedicated "flex-fuel" vehicles (FFVs), which can run on any combination of gasoline and ethanol blends (up to 85%). However, in some jurisdictions, it may be challenging to find a local supplier of E85 as it is only available through specialized providers.

<u>Emissions Reduction Potential:</u> Emissions reductions from using ethanol as fuel instead of pure gasoline varies according to biomass used and percentage blend. Although the production and burning of ethanol produce emissions, the absorption of carbon dioxide from the growing of feedstocks can result in the net effect being a large reduction of GHG emissions compared to fossil fuels such as gasoline. The higher the ethanol blend, the greater the GHG reductions[35].

Ethanol, specifically E10 made from corn, yields a 3-4% reduction in lifecycle GHG emissions compared to gasoline. E10 derived from wood or agricultural cellulosic materials achieves a 6-8% reduction[35]. Corn-based E85 can cut lifecycle GHG emissions by 25-50%[36], while cellulosic feedstocks can achieve reductions ranging from 88-108% compared to refined petroleum[37]. This implies potential carbon capture or avoidance during production and use. In terms of tailpipe emissions, E85 shows a GHG reduction potential of about 30% compared to gasoline[38], but due to its lower energy content, approximately 37% more E85 is needed for the same work, resulting in a net emissions reduction of about 4.1%.

<u>Ethanol Cost:</u> Given the energy losses per unit volume as compared to gasoline, the lower cost of E85 per unit volume compared to gasoline does not offset the higher volume required to achieve the same distance travelled, likely making E85 more expensive than gasoline. Based on April 2020 fuel prices in the US, and accounting for energy equivalence (i.e., same distance travelled), E85 is about 16% costlier than gasoline[39].

<u>Flex-Fuel Vehicles:</u> Flex-fuel vehicles are designed to run on E85, a blend of ethanol and gasoline. Unlike conventional gasoline engines, flex-fuel vehicles feature specialized fuel systems to handle ethanol blends ranging from 0% to 85%. Despite the larger fuel tank required due to ethanol's lower energy efficiency, flex-fuel vehicles match conventional ones in terms of power, acceleration, payload, cruise speed, and pricing. Many of the Town's current vehicles may be flex-fuel capable.

<u>Ethanol Supply and Storage:</u> E85 is rarely available at retail fuel stations and would be difficult to procure in Wasaga Beach. E85 can be delivered direct-to-vehicle. Alternatively, it can be stored and dispensed in bulk from an onsite fuel station. Ethanol tanks require a water monitoring system. In addition, a 10-micron filter, signage, and other upgrades are required to ensure the system is compliant.

[34] Source: https://afdc.energy.gov/fuels/ethanol_fuel_basics.html
[35] Source: https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/alternative-fuels/biofuels/ethanol/3493
[36] Source: https://www.tandfonline.com/doi/pdf/10.3155/1047-3289.59.8.912
[37] Source: https://afdc.energy.gov/fuels/ethanol_benefits.html
[38] Source: http://www.patagoniaalliance.org/wp-content/uploads/2014/08/How-much-carbon-dioxide-is-produced-by-burning-gasoline-and-diesel-fuel-FAQ-U.S.-Energy-Information-Administration-EIA.pdf
[39] Source: https://afdc.energy.gov/fuels/prices.html

Overall, E85 has an excellent lifecycle emissions reduction potential for a fleet, particularly when the fleet is already E85 capable (i.e., has flex-fuel vehicles). The drawback is that there are energy losses per unit volume as compared to gasoline, which may make E85 more expensive because more is required to achieve the same distance traveled. If electric vehicles are not a viable option, new light-duty vehicles purchases should be flex-fuel capable to further enhance the GHG emissions reduction potential for a fleet. The implementation of E85 vehicles can be expedient as there are only minimal costs and effort required to prepare the infrastructure for E85 storage. E85 supply is not available at any fuel station in Ontario, and would therefore be difficult to procure for the Town[40].

Compressed Natural Gas (CNG)

Natural gas, a fossil fuel composed of mostly methane, is one of the cleanest burning alternative fuels. It is also thought to be safer than traditional fuels since, in the event of a spill, natural gas is lighter than air and thus disperses quickly when released. Natural gas can be used in the form of compressed natural gas (CNG) or liquefied natural gas (LNG) to fuel cars and trucks, although CNG is the more common technology due to ease of transportation and storage of the fuel. Vehicles that use natural gas in either form are called natural gas vehicles (or NGVs). Natural gas is abundant in rock formations and above oil deposits. Extracted, processed, and compressed, it is stored and transported by pipeline. CNG is employed in modified gasoline vehicles or those manufactured for CNG use—either exclusively, with a segregated gasoline system (dual-fuel), or alongside another fuel like diesel (bi-fuel). Due to its larger fuel tank requirement, CNG is more prevalent in fleet vehicles such as buses and heavy-duty trucks[41].

In Canada, business case modelling[42] demonstrated that the use of natural gas by medium and heavy-duty truck applications provides economic and environmental benefits. The cost and placement of natural gas storage tanks is the major barrier to wider and quicker adoption of CNG as a fuel. However, CNG offers many advantages for fleets, and although there are major upfront capital costs associated with the CNG fueling station installation, which may exceed $1M, savings may ensue.

Emissions Reduction Potential: Based on the same work performed, a CNG vehicle has tailpipe GHG emissions approximately 20-30% less than a comparable diesel vehicle[43,44]. NGVs also emit up to 95% less nitrogen oxides (NOx) compared to diesel and gasoline vehicles[45]. Furthermore, CNG vehicles do not emit particulate matter (PM10), a main cause of air pollution[46].

Feasibility Considerations: The business case for natural gas relies on the fuel cost advantage over diesel, offsetting higher initial NGV investment. New NGVs may cost up to $50,000 more than diesel vehicles, with longer payback periods for buses[47,48]. Operational challenges include limited yard space for natural gas tanks, and potential disruptions to slow-fill refueling during power outages, impacting emergency preparedness. Dedicated CNG vehicles face risks like compressor failure, necessitating effective risk management.

Infrastructure Costs: Establishing a CNG filling station infrastructure incurs costs upwards of $500,000[49], varying based on capacities and complexities. The components include a compressor, storage facilities, dispensers, slow and fast-fill positions, engineering and permitting, and site preparation with gas service. This is a conservative estimate capturing key elements of the infrastructure setup. There are three main types of CNG fuelling stations: slow-fill refuellers (use a compressor only; fuelling typically takes place

[40] Source: https://www.gasbuddy.com/gasprices/ontario
[41] Source: Energy Explorer: Compressed Natural Gas vs. Liquified Natural Gas (consumerenergyalliance.org)
[42] Source: Natural Gas Use in the Medium and Heavy Duty Vehicle Transportation Sector in Roadmap 2.0 June 2019
[43] Source: https://brc.it/en/categorie_faq/cng/
[44] Source: Envoy Energy | Compressed Natural Gas vs. Liquefied Natural Gas
[45] Source: Northwest Gas Association – Natural Gas Facts
[46] Source: https://brc.it/en/categorie_faq/cng/
[47] Source: Closing the Loop. Canadian Biogas Association. 2015.
[48] Source: Consultations with Change Energy
[49] Source: https://www.nrel.gov/docs/fy14osti/62421.pdf

overnight), fast-fill refuellers (storage capacity is required; fuelling is 8 minutes per vehicle), and hybrid refuellers: have both slow and fast-fill-up.

Safety: According to the U.S. Department of Energy's Alternative Fuels Data Center, NGVs are safer than vehicles powered by gasoline or diesel and the industry is highly regulated to address any additional safety concerns. There are an estimated 11 million NGVs[47] in use in over 30 countries globally. Codes, standards and regulations are in place to ensure that CNG vehicles are safe and that CNG refueling stations have been installed according to industry standards. CNG has several inherent properties that differentiate it from diesel or gasoline, including the following:

- It has a higher ignition temperature than gasoline (about 1022°F, compared to about 482°F for gasoline).
- Natural gas burns only if the concentration in air is within specific limits, which is between 5-15%; this property along with a high ignition temperature make combustion of CNG very unlikely.
- It is lighter than air, thus in the unlikely event of a leak it dissipates quickly into the atmosphere.
- In addition, the CNG industry is highly regulated and there are a series of safety measures in place, including the following:
    - Natural gas is odourless; however, for safety reasons it is odorized to enable easy leak detection.
    - Fuel cylinders are stronger than diesel tanks and fuel tanks.
    - Cylinders and tanks are fitted with valves to handle high pressure, prevent leakage and eliminate risks of explosion

Market Scan: The CNG vehicle market in Ontario is growing gradually due to increasing environmental awareness and the need for cleaner fuel alternatives. However, the market is still relatively small compared to traditional gasoline and diesel vehicles. The use of CNG vehicles is mostly seen in commercial fleets, such as transit buses and trucks, and not typically in small-scale transit operations due to initial infrastructure costs.

Several vehicle manufacturers offer CNG vehicles in Ontario such as Ford, General Motors, and Fiat Chrysler[50]. Generally though, the vast majority of natural gas vehicles are medium or heavy-duty vehicles. Additionally, there are companies like Enbridge Gas Distribution and Union Gas that provide natural gas for vehicles. The infrastructure for CNG vehicles in Ontario is still developing. As of now, there are nine public CNG refuelling stations across the province, with the closest one to Wasaga Beach being at Toronto Pearson International Airport[51].

Despite the potential growth, there are several challenges that the CNG vehicle market faces in Ontario. These include the high upfront cost of CNG vehicles, limited infrastructure, and the lack of consumer awareness about the benefits of CNG vehicles.

Total Cost of Ownership: Due to the low cost of fuel, the technology is most cost effective for vehicles travelling long distances, and as such has traditionally been available for buses and tractor trailers. Given the Town's average annual mileage of heavy-duty vehicles is less than 9,000 km, this is less than ideal conditions for the purchase of CNG vehicles. CNG vehicles were compared in the Deloitte Total Cost of Ownership Tool for class 6, 7, and 8 trucks with inputs based on the Town's fleet. The following is the assumptions used to calculate the total cost of ownership:

[50] Source: https://cngva.org/go-natural-gas/vehicles/#vehicles4
[51] Source: https://afdc.energy.gov/fuels/natural_gas_locations.html#/find/nearest?fuel=CNG

Table 9. Assumptions for the total cost of ownership calculation for CNG and diesel class 6, 7, and 8 trucks

CNG Total Cost of Ownership Assumptions	Diesel Total Cost of Ownership Assumptions
Purchasing Costs: • ***Vehicle Price = $270,000***[52] • ***Term = 5 years***[53] • ***Interest Rate = 8%***[54] • ***Ownership Period = 14 years***[55]	**Purchasing Costs:** • *Vehicle Price = $200,000*[56] • *Term = 5 years*[57] • *Interest Rate = 8%*[58] • *Ownership Period = 14 years*[59]
Fuel Costs: • ***Fuel Efficiency = $0.35/km*** • ***Mileage = 8,907 km***[60] • ***Number of Fueling Stations = 0***	**Fuel Costs:** • *Fuel Price = $1.65/L*[61] • *Mileage = 8,907 km*[62] • *Fuel Efficiency = 2.86 km/L*[63]
Non-energy Operating Costs: ***C) Insurance = $12,000***[64] ***D) Repairs & Maintenance = $9,450/year***[65]	**Non-energy Operating Costs:** • *Insurance = $12,000*[66] • *Repairs & Maintenance = $9,450/year*[67]

The result was a total cost of ownership of approximately $57,000 more over the lifetime of the truck if a CNG truck is purchased, as seen in Figure 19.

[52] Source: https://www.traceyroad.com/natural-gas-truck-vs-diesel-whats-right-for-you/
[53] Source: https://www.mortgagecalculator.org/calcs/truck.php#:~:text=The%20average%20life%20of%20a,have%20less%20inherent%20collateral%20value.
[54] Source: https://smarter.loans/truck-loans/
[55] Source: Based on the recommended lifecycles from the LCA analysis of class 8 trucks in Appendix A
[56] Source:https://www.durabakcompany.com/blogs/durabak/how-much-does-a-semi-truck-cost
[57] Source: https://www.mortgagecalculator.org/calcs/truck.php#:~:text=The%20average%20life%20of%20a,have%20less%20inherent%20collateral%20value.
[58] Source: https://smarter.loans/truck-loans/
[59] Based on the recommended lifecycles from the LCA analysis of class 8 trucks in Appendix A
[60] Wasaga Beach average annual heavy-duty mileage
[61] Source: https://www.gasbuddy.com/gasprices/ontario/wasaga-beach
[62] Wasaga Beach average annual heavy-duty mileage
[63] Source: https://natural-resources.canada.ca/energy/efficiency/transportation/commercial-vehicles/reports/7607
[64] Source: https://lethbridgeinjurylawyer.ca/commercial-truck-insurance-cost-alberta/
[65] Source: https://www.nrel.gov/docs/fy22osti/82081.pdf
[66] Source: https://lethbridgeinjurylawyer.ca/commercial-truck-insurance-cost-alberta/
[67] Source: https://www.nrel.gov/docs/fy22osti/82081.pdf

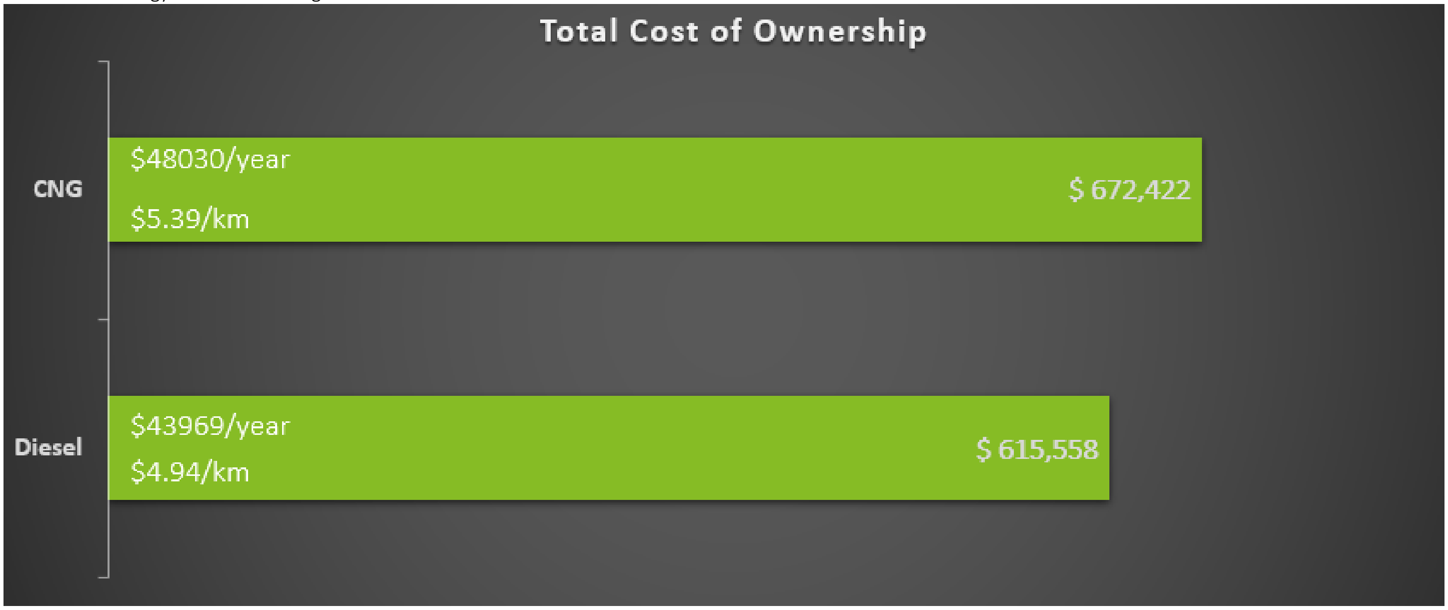

Figure 19. CNG total cost of ownership versus the conventional diesel vehicle for heavy-duty trucks, assuming inputs tailored to the Town's fleet

Due to the higher cost of ownership of CNG vehicles for the Town, the technology was not considered when designing the Green Fleet Strategy.

Understanding Hydrogen Fuel Cell Technology

Hydrogen fuel cells are able to produce electricity for the vehicle with zero tail-pipe emissions and therefore offer environmental benefits. Fuel cell electric vehicles (FCEVs) use a fuel cell instead of a battery to power its electric motor. Hydrogen is stored as fuel compressed in a tank. The hydrogen stores energy, flows into a fuel cell, reacts with oxygen from the air, creates electricity that flows into a battery, that powers the electric motor. Although fuel cell technology has been around since 1960 (GM introduced the first fuel cell vehicle, the Electrovan, in 1966), adaptation of the technology has been slow. Only in recent years, supported by the focus on zero-emissions technologies, has the hydrogen fuel cell regained momentum. Leading (light-duty) vehicle manufacturers including Honda, Toyota and Hyundai have launched their first mass-production hydrogen-powered vehicles.

FCEVs are like electric vehicles in that they use an electric motors to power the drive wheels and have no greenhouse gas tail-pipe emissions. Rather than being plugged in to charge a battery, these vehicles use onboard fuel cells to generate electricity. In a fuel cell, hydrogen from the fuel tank (filled similarly to gasoline/diesel) is combined with oxygen from the air to electrochemically generate electricity. Water is also produced in this process. The electricity generated flows into a battery and is used to power the vehicle. Fuel cells have particular benefits over electric vehicle technology, namely they can provide extended range and offer rapid refueling to satisfy driver requirements.

Technological Advancement

One of the main issues with FCEVs has been the shortage of hydrogen fuelling stations. Its the proverbial "chicken or egg" scenario with manufacturers not willing to produce vehicles that customers cannot fuel, while developers are reluctant to build hydrogen stations (costing $2,000,000 or more[68]).

There are several medium and heavy-duty hydrogen vehicles being developed. Overall, fuel cell technology has a potential for future applications for vehicles, especially for long haul trucking and buses

[68] Source: https://venair.com/en/blog/articles/cost-h2-fuel-station#:~:text=It%20is%20estimated%20that%20at,around%201.5%2D2%20million%20USD.

where the benefits of quick refueling are amplified. Nevertheless, the technology currently is still expensive, lifecycle emissions are high (depending on hydrogen production process), and fuelling stations are not easily available. As a result, any projections of fuel cell application in the future must be approached with caution and an understanding of the inherent limitations.

Health and Safety

One of the primary health benefits of FCEVs is their zero tail-pipe emissions. Unlike traditional internal combustion engines that emit harmful pollutants like carbon monoxide, nitrogen oxides, and particulate matter, FCEVs only emit water vapor and heat, significantly reducing air pollution. This reduction in air pollution can have substantial positive impacts on public health, especially in urban areas where vehicle emissions contribute significantly to air quality issues. By reducing exposure to these harmful pollutants, rates of respiratory diseases and heart issues are reduced.

Despite the health benefits, FCEVs use hydrogen as a fuel source, which, while being an efficient energy carrier, is also highly flammable. FCEVs must meet the same federal safety standards that apply to conventional vehicles[69]. FCEVs have undergone extensive testing to ensure their safety and designed with numerous safety features to manage this risk. Hydrogen tanks are built to withstand severe impacts, high temperatures, and environmental hazards. In case of a leak, hydrogen, being lighter than air, dissipates rapidly, reducing the chance of ignition. Additionally, FCEVs are equipped with sensors to detect leaks[70] and are equipped with pressure relief devices that vent hydrogen safely away from the vehicle and its occupants in case of a crash[71].

Although FCEVs appear to be safe, the effectiveness of the pressure relief device has not been thoroughly studied, and there has not been enough incidents to conclusively say whether a fuel cell or a gasoline engine is more safe than the other.

Hydrogen Fuel Cell Vehicles Market Availability

FCEVs are being developed for a broad spectrum of vehicle categories, from light-duty cars to heavy-duty trucks and transit buses. Currently, only Toyota and Hyundai sells passenger and small SUV models in Canada. As the Town’s fleet mainly consists of light-duty pickup trucks and SUVs, vehicle availability will influence the rate of transition. The S&P Global Engine Production Forecast (2023) was used to map how the commercial landscape may evolve out to 2030. FCEV options for light-duty trucks and SUVs are expected within the next five years, potentially making them a long-term alternative for the Town’s fleet, assuming public fueling stations are installed in Wasaga Beach and fuel prices decrease.

As Figure 20 demonstrates, global light-duty production volumes of fuel cell vehicles are projected to increase year over year by an average of 36% from 2023 to 2030[72].

[69] Source: https://www.epa.gov/greenvehicles/hydrogen-transportation
[70] Source: https://www.epa.gov/greenvehicles/hydrogen-transportation
[71] Source: https://www.osti.gov/servlets/purl/1570250
[72] Source: S&P Global. “Mobility Light Vehicle Powertrain Forecast,” data retrieved November 2023.

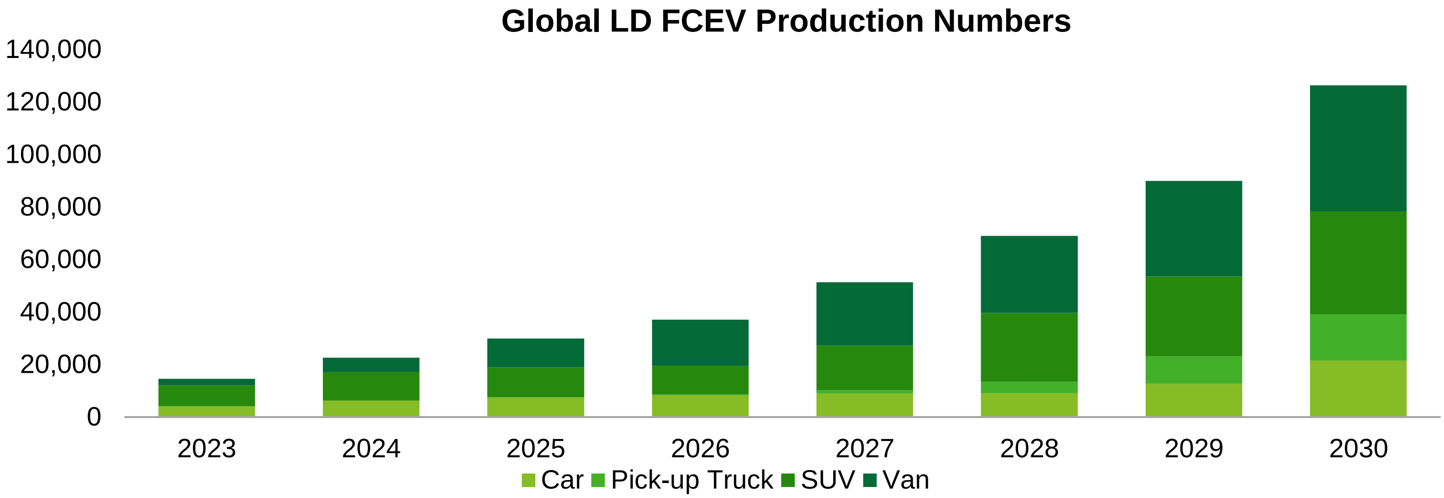

Figure 20: Projected global FCEV production numbers 2023-2040[72]

This growth rate suggests approximately 126,000 light-duty FCEV vehicles in production in 2030 compared to 14,600 in 2023, a 765% increase globally. While this is a significant increase and demonstrates OEMs have interest in FCEV technologies, the production numbers are still low compared to battery electric vehicles. Another key consideration is the degree to which these light-duty FCEV models will be sold in Canada and the relevance to the Town's fleet.

Table 10. Currently available light-duty models and specifications

Make and model	Vehicle type	Propulsion system	Range	Storage pressure	Base MSRP
Toyota Mirai	Car	FCEV	650 km	700 bar	CA$54,350
Hyundai Nexo	SUV	FCEV	570-612km	700 bar	CA$72,500

The Toyota Mirai (car) and Hyundai Nexo (SUV), manufactured in Japan and South Korea respectively are both available in Canada. For the Toyota Mirai, production for FY2024 is expected to be approximately 4,900 with a compound annual growth rate (CAGR) of 11.6% until FY2030 where it reaches approximately 9,500 vehicles. For the Hyundai Nexo, production for FY2024 is expected to be approximately 9,700 with a CAGR of 7.9% until FY2030 where it reaches just over 15,300 vehicles.

The following list of FCEV production forecasts (Table 12) and FCEV availability (Table 12) are non-exhaustive lists that are focused on vehicles that have the potential to be available in the Canadian market.

Table 11. Projected car production volumes from 2023 to 2030

Vehicle-Type	Make and model	Annual production volume								Production location
		FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	
Cars	**Toyota Mirai**	3,842	4,936	4,504	4,660	4,549	4,218	7,604	9,513	Japan
	Toyota Crown	120	567	538	372	436	355	266	905	Japan

SUVs	**Hyundai Nexo**	8,041	9,737	9,530	8,015	11,299	15,532	15,016	15,356	South Korea
	Honda CR-V	0	501	555	559	278	0	0	0	United States
	Honda C-CUV EV	0	0	0	0	857	2,074	2,482	4,054	United States
	Kia D-SUV	0	0	0	0	0	0	803	2,042	South Korea
Vans	**Fiat Ducato**	0	292	956	1,546	1,781	1,777	1,350	2,222	Italy, Poland
	Hyundai Staria	0	0	601	2,332	3,033	4,104	3,620	2,359	South Korea
	Ram ProMaster	0	0	238	475	900	2,766	3,848	3,901	Mexico
	Toyota Hiace	0	0	0	1,393	1,496	1,548	1,489	1,457	Japan
	Hyundai Mighty	0	0	0	311	473	604	761	1,105	South Korea
	Hyundai Solati	0	0	0	15	111	110	113	131	South Korea
	Mitsubishi Fuso Canter	0	0	0	0	0	34	54	88	Japan
	Cruise Origin	0	0	0	0	0	23	87	153	United States
	Ford Transit	0	0	0	0	0	0	1,309	1,459	Turkey
	Volkswagen Crafter	0	0	0	0	0	0	418	498	Turkey
Pickups	**Chevrolet Colorado EV**	0	0	0	127	315	335	426	692	Mexico
	GMC D-Pickup EV	0	0	0	85	197	209	275	476	Mexico
	Chevrolet Silverado HD	0	0	0	0	0	1,749	2,142	3,258	United States
	GMC Sierra HD	0	0	0	0	0	1,284	1,574	2,497	United States
	Ford F-250/350 Super Duty	0	0	0	0	0	0	4,703	6,382	United States
	Ram 2500/3500	0	0	0	0	0	0	655	2,808	Mexico
	Toyota Tundra	0	0	0	0	0	0	0	629	United States

There are several heavy-duty FCEV truck and bus models either currently available or expected in the North American market before 2030 as outlined in Table 12.

Table 12. Projected FCEV heavy-duty trucks and buses from 2024 to 2030

Vehicle-Types	Make and model	Gross vehicle weight	Hydrogen storage pressure	Range	Commercial availability
Trucks	**Hyundai Xcient**	36 tonnes	350 bar	400 km	Available in North America in 2025.
	Nikola Tre	37 tonnes	700 bar	800 km	Available in Canada. First deliveries expected mid-2024.
	Kenworth T680 FCEV	37 tonnes	350 bar	720 km	Now accepting deposits in Canada with deliveries expected in 2024.
	HYZON HYHD8-110	37 tonnes	350 bar	560 km	Available in Canada. First deliveries expected in 2024.
	HYZON HYHD8-200	37 tonnes	350 bar	560 km	Available in Canada. First deliveries expected in 2024.
	HYZON Refuse (Waste collection)	29 tonnes	350 bar	200 km	Available in Canada. Customer deliveries expected to begin in 2025.
Buses	**New Flyer Xcelsior CHARGE FC (40 foot)**	20 tonnes	350 bar	600 km	Available in Canada
	New Flyer Xcelsior CHARGE FC (60 foot)	33 tonnes	350 bar	600 km	Available in Canada
	ENC Axess EVO-FC (40 foot)	20 tonnes	350 bar	650 km	Available in Canada

Although there are many FCEVs expected to be available between 2024 – 2030, only one sedan, one SUV, and several buses are currently available for delivery in Ontario.

Grants and Incentives

Fuel cell vehicles have a wide range of incentives offered by Natural Resources Canada (NRCan), Infrastructure Canada, and Transport Canada. For medium and heavy duty vehicles, Transport Canada offers up to $200,000 in purchase incentives, while offering $5,000 for light-duty vehicles. Infrastructure Canada also offers up to 50% of the cost of a new fuel cell bus and/or the supporting infrastructure. Meanwhile, NRCan offers 50% off the cost of hydrogen refueling infrastructure for all types of fuel cell vehicles. Notably, fueling infrastructure costs on average exceed $2.6M[73], resulting in high installation costs, even when considering the incentives available. Please see Appendix E for the table of applicable incentives for the Town's fleet.

Total Cost of Ownership

Due to the high cost of hydrogen fuel, the technology's cost over its lifetime is more comparable to other technologies at lower annual mileages. This means that although the technology is most beneficial when

[73] Source: https://www.hydrogen.energy.gov/docs/hydrogenprogramlibraries/pdfs/21002-hydrogen-fueling-station-cost.pdf?Status=Master

traveling long distances (due to its energy density and ability for quick refueling), it is most expensive when operating as such. Given the Town's average annual mileage of heavy-duty vehicles is less than 9,000 km, this is actually preferable conditions when comparing the technology to traditional diesel trucks. FCEVs were compared in the Deloitte Total Cost of Ownership Tool for class 6, 7, and 8 trucks with assumptions based on the Town's fleet. The following are the assumptions used to calculate the total cost of ownership:

Table 13. Assumptions for the total cost of ownership calculation for FCEV and diesel class 6, 7, and 8 trucks

FCEV Total Cost of Ownership Assumptions	Diesel Total Cost of Ownership Assumptions
Purchasing Costs: • ***Vehicle Price = $520,000***[74] • ***Vehicle Incentives = $200,000***[75] • ***Term = 5 years***[76] • ***Interest Rate = 8%***[77] • ***Ownership Period = 14 years***[78]	**Purchasing Costs:** • *Vehicle Price = $200,000*[79] • *Term = 5 years*[80] • *Interest Rate = 8%*[81] • *Ownership Period = 14 years*[82]
Fuel Costs: • ***Fuel Cost = $14.70/kg***[83] • ***Fuel Efficiency = 11.0 km/kg***[84] • ***Mileage = 8,907 km***[85] • ***Number of Fueling Stations = 0***	**Fuel Costs:** • *Fuel Price = $1.65/L*[86] • *Mileage = 8,907 km*[87] • *Fuel Efficiency = 2.86 km/L*[88]
Non-energy Operating Costs: • ***Insurance = $12,000 (value is not publicly available and was made equivalent to the diesel vehicle to ensure comparability)*** • ***Repairs & Maintenance = $9,500/year***[89]	**Non-energy Operating Costs:** • *Insurance = $12,000*[90,91] • *Repairs & Maintenance = $9,450/year*[92]

[74] Source: https://theicct.org/wp-content/uploads/2022/02/purchase-cost-ze-trucks-feb22-1.pdf
[75] Source: https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/medium-heavy-duty-zero-emission-vehicles/imhzev-eligible-vehicles
[76] Source: https://www.mortgagecalculator.org/calcs/truck.php#:~:text=The%20average%20life%20of%20a,have%20less%20inherent%20collateral%20value.
[77] Source: https://smarter.loans/truck-loans/
[78] Based on the recommended lifecycles from the LCA analysis of class 8 trucks in Appendix A
[79] Source: https://www.durabakcompany.com/blogs/durabak/how-much-does-a-semi-truck-cost
[80] Source: https://www.mortgagecalculator.org/calcs/truck.php#:~:text=The%20average%20life%20of%20a,have%20less%20inherent%20collateral%20value.
[81] Source: https://smarter.loans/truck-loans/
[82] Based on the recommended lifecycles from the LCA analysis of class 8 trucks in Appendix A
[83] Source: https://www.htec.ca/faqs/
[84] Source: https://theicct.org/publication/fuel-cell-tractor-trailer-tech-fuel-jul22/
[85] Wasaga Beach average annual heavy-duty mileage
[86] Source: https://www.gasbuddy.com/gasprices/ontario/wasaga-beach
[87] Wasaga Beach average annual heavy-duty mileage
[88] Source: https://natural-resources.canada.ca/energy/efficiency/transportation/commercial-vehicles/reports/7607
[89] Source: https://www.nrel.gov/docs/fy22osti/82081.pdf
[90] Source: https://lethbridgeinjurylawyer.ca/commercial-truck-insurance-cost-alberta/
[91] Source: https://insurancehero.ca/transportation-insurance/
[92] Source: https://www.nrel.gov/docs/fy22osti/82081.pdf

The result was a total cost of ownership of approximately $240,000 more over the lifetime of the truck if a FCEV truck is purchased, as seen in Figure 21. Given the lack of available hydrogen vehicle, fuel, and insurance cost data, this difference may be greater.

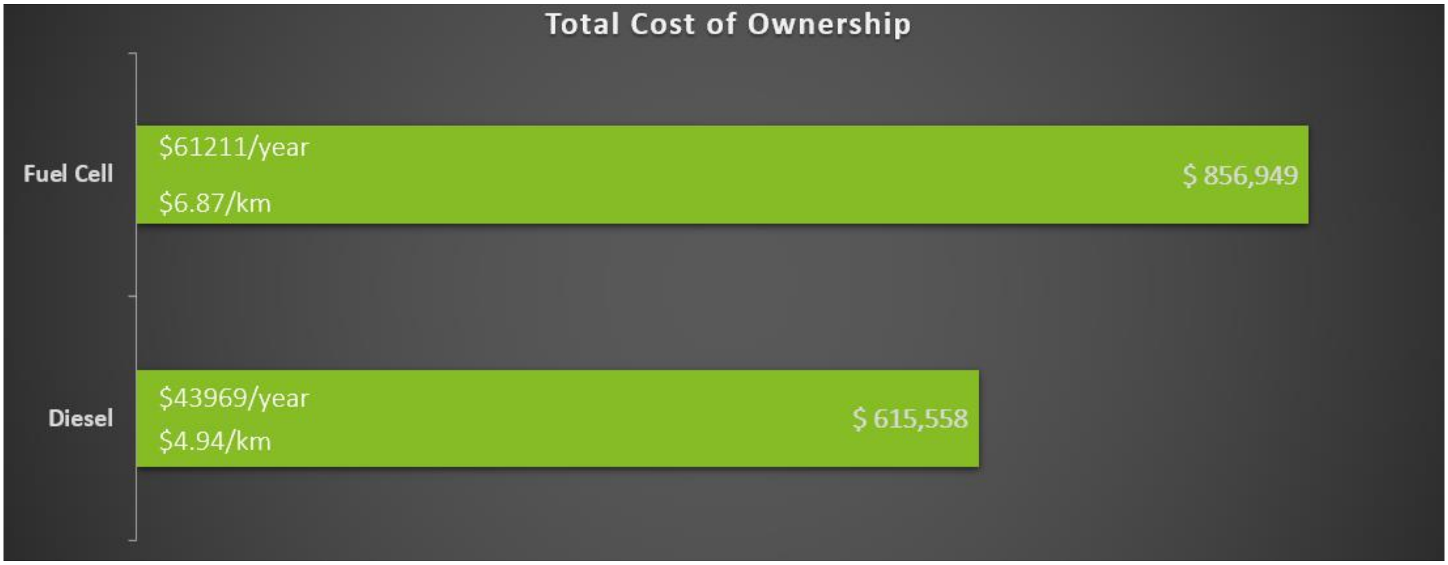

Figure 21. Fuel cell total cost of ownership versus the conventional diesel vehicle for heavy-duty trucks, assuming inputs tailored to the Town's fleet

This cost of ownership does not take into consideration the cost of a fueling station. Due to there being no publicly available fueling stations in Ontario, the Town would have to purchase their own fueling station. This would cost approximately $2.35 million; although with incentives that cost could be cut by 50%[93]. Due to the high cost of purchasing and operating, as well as difficulty in sourcing hydrogen in the Town of Wasaga Beach in the medium-term, FCEVs were not further considered in the Green Fleet Strategy.

Understanding Battery Electric Technology

Emissions

Battery-electric vehicles (BEVs) rely on electricity as their "fuel" for recharging batteries, making them categorized as zero-emission vehicles (ZEVs)[94]. To achieve zero well-to-wheel GHG emissions, BEVs must be charged with electricity from renewable sources like wind, solar, hydroelectric, or nuclear power. If charged by electricity generated using fossil fuels, BEVs cannot be considered true ZEVs[95]. Ontario's electricity system is roughly 90% generated from clean electricity sources, making BEVs net emissions low.

Up the supply chain, a common misconception is that the emissions from manufacturing offset the reduction in tail-pipe emissions for BEVs relative to ICE and diesel vehicles. According to Bloomberg, BEV emissions over the life of the vehicle are over 70% lower than gasoline and diesel vehicles. BEVs also become a cleaner option after the first 40,000 km of driving, as tail-pipe emissions benefits surpass the emissions incurred from manufacturing[96].

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[93] Source: https://natural-resources.canada.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876
[94] Source: https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/incentives-zero-emission-vehicles-izev
[95] Source: California Air Resources Board (2009-03-09). "Glossary of Air Pollution Terms: ZEV"
[96] Source: https://www.bloomberg.com/news/newsletters/2024-03-21/evs-are-much-lower-emitting-than-combustion-cars?embedded-checkout=true

Health and Safety

BEVs and electric vehicle charging stations (EV chargers) have become increasingly popular as a sustainable transportation alternative.

Safety-wise, EVs are designed with high safety standards. They undergo the same rigorous testing as traditional vehicles and must meet the same safety regulations. For example, the Tesla Model 3 and Model Y earned perfect scores in all of National Highway Traffic Safety Administration (NHTSA) safety ratings. One reason for this is due to the low center of gravity of BEVs with the battery in the floor between the front and rear axle, resulting in low rollover risk[97] EV batteries are also designed with multiple safety layers, including thermal management systems to prevent overheating and robust enclosures to protect against physical damage.

EV chargers are also built with safety in mind. They are equipped with several safety features, such as ground-fault circuit interrupter (GFCI) protection to prevent electric shocks, and communication protocols that ensure the charger only delivers power when connected to an EV and stops charging if a fault is detected. Moreover, they must comply with international safety standards such as IEC 61851.

However, it's critical that BEVs and BEV chargers are used and maintained correctly to ensure their safety, such as using a charger with the correct voltage level for the specific BEV model.

BEVs, although much less likely to catch fire compared to internal combustion engine[98,99] vehicles, present unique challenges for emergency responders due to the risk of thermal runaway in batteries. Firefighters must use substantial amounts of water or specialized fire-extinguishing agents to cool the battery and prevent re-ignition. Emergency response protocols emphasize the need for isolating the vehicle, wearing appropriate protective gear, and being aware of the potential for toxic fumes.

Charging Technologies

The time it takes to fully charge an EV is dependent on the type (level) of charger used, the vehicle's technology (i.e., the maximum amount of current allowed by the vehicle, in amps), and range (i.e., battery capacity). Charging speed is expressed in kilometers/miles of range per hour of charging. EVs can be charged by varying levels of chargers ranging from Level 1-3 with the following general characteristics shown in Table 14[100]:

Table 14. Characteristics of EV Charging Levels

EV Charging Levels	Outlet Voltage	Amperage	Added Range Per Hour
Level 1	120 V	12 - 16 Amps	5 – 10 km
Level 2	240 V	16 - 40 Amps	22 – 56 km
Level 3	480+ V	100+ Amps	>250 km

Level 1 chargers can be plugged right into a standard outlet. They are the most economical option for private owners; however, at such a low charging rate it is usually not practical to use Level 1 chargers exclusively. For example, it could take about 40 hours to fully charge a light-duty EV with a range of 400 km starting at 20% battery (80 km range remaining).

Level 2 chargers are common in private households as well as public spaces such as mall parking lots. They incur an installation cost but are similar to common 240V installations such as the outlets that power clothes dryers. For a light-duty EV with a range of 400 km and at 20% battery, it could take about eight

[97] Source: https://electrek.co/2021/01/14/tesla-explains-top-safety-rating-model-y-lowest-rollover-risk/
[98] Source: https://core.verisk.com/Insights/Emerging-Issues/Articles/2023/August/Week-4/Electric-Vehicle-Fire-Risk
[99] Source: https://www.autoinsuranceez.com/gas-vs-electric-car-fires/
[100] Source: https://calevip.org/electric-vehicle-charging-101

hours to fully charge. Level 2, 240-volt chargers typically range in cost from around $1,500-$5,000[101], depending on electrical system requirements and capacity. For the Town of Wasaga Beach, installation costs are expected to be greater than this range due to the charger installations occurring in a parking lot rather than close to the building, resulting in the purchase of a pedestal and trenching services. This results in a price per Level 2 charger of approximately $17K[102], or $9K after incentives (see Appendix E).

Where time of use rates are in place, charging is typically done overnight during the off-peak period. The vast majority of the time, EV owners only need a Level 2 charger; the exception is when travelling longer distances, or for medium and heavy-duty vehicles. During these times, much faster charging rates are required through Level 3 charging.

Level 3, or direct current fast chargers (DC fast chargers), are specialized systems designed to quickly charge vehicles and provide flexibility to owners travelling longer distances or in need to partially quick charge. For a light-duty EV with a range of 400 km and at 20% battery, it would typically take less than one hour to fully charge. Installations of Level 3 chargers require a commercial electrician due to the electrical load and wiring requirements. The costs for installation greatly depends on the electrical supply available at the chosen charging site. Site preparation costs including trenching, cable runs, and many other installation considerations. Equipment and installation costs for DC fast charging stations can range from $26,000[103] - $50,000[104].

Impact of Temperature on Battery Performance

Extreme temperatures in Canada impact electric vehicle (EV) range due to auxiliary heating for both the vehicle cabin and battery. EV owners can mitigate temperature effects by pre-conditioning their vehicle and keeping it plugged in during extreme temperatures. This approach helps maintain battery temperature control and extends battery life[105]. Electric vehicles, along with gasoline and hybrid vehicles, can expect declines in fuel economy in cold weather according to the Department of Energy[106], as illustrated in Table 15.

Table 15. Decline in range of gasoline, hybrid, and electric vehicles in cold weather (-7°C) relative to warm weather (25°C)

Vehicle-Type	Change in Fuel Economy (MPG or MPG-equivalent) on Short Trips
Gasoline	15% to 33% decline
Hybrid	25% to 45% decline
Electric	39% decline
Electric (without cabin heat running)	12% decline

Due to auxiliary heating, electric vehicles range can change drastically in cold weather, and should be accounted for before long trips. It's also worth considering which electric vehicle you purchase, since different vehicles have different battery chemistries. For example, at freezing temperatures, a 2022 Chevrolet Bolt can experience a decline in range of 42%, while on the lower end, a Tesla Model 3 and

[101] Source: https://calevip.org/electric-vehicle-charging-101
[102] Based on Wasaga Beach's past L2 charging projects' supply costs and installation/trenching costs, on a per charger basis (rather than on a per dual pedestal basis)
[103] According to Wasaga Beach's previous Level 3 installation cost
[104] Source: https://pub-goderich.escribemeetings.com/filestream.ashx?DocumentId=11079
[105] Source: https://www.geotab.com/blog/ev-range/
[106] Source: https://www.energy.gov/energysaver/fuel-economy-cold-weather

Tesla Model Y can expect a reduction in range of 24%[107]. Also performing relatively well is the Ford F-150 Lightning, with a reduction in range of 26%[108].

Battery Replacement and Energy Storage

EV manufacturers typically offer an eight-year or 100,000-mile warranty on batteries[105], but these batteries are predicted to last 10-20 years, depending on usage[109]. Consumer Reports estimates the average EV battery pack's lifespan is around 322,000 kilometers. Therefore, the vehicle will often reach its end-of-life before there is a need for battery replacement.

Battery degradation is a gradual process, and drivers may start to notice a decline in range when capacity falls below 80%[109]. This is likely to occur at or after the typical vehicle replacement age. When EV batteries eventually reach the end of their working life, recycling becomes crucial. Current recycling processes recover about 95% of the materials in an EV battery pack[110], including valuable components like cobalt, lithium salts, stainless steel, copper, aluminum, and plastic. With the expected surge in EV popularity, car manufacturers are actively working to improve recycling rates and sustainability in handling end-of-life batteries.

Training Options

Before EVs are deployed in a fleet to any great extent, we recommend high-voltage training for technicians. Published high-voltage guidelines specific to vehicle technicians servicing EVs are not readily available through traditional sources. However, we suggest that anyone working with high voltage in any format, including EVs, should be provided guidance on applying Occupational Health & Safety Management System fundamentals. This includes a "plan, do, check, and act" philosophy while working with energized electrical equipment[111]. Such training is available for non-electrical workers from Lineman's Testing Laboratories (LTL) of Weston, Ontario. LTL offers an awareness-level course for non-electrical workers which is claimed by the company to provide a basic-level understanding of workplace electrical safety.

Aside from awareness training, fleet technicians should also have access to, and be trained on the use of, electrical-specific personal protective equipment (PPE). Such PPE would include tested and certified non-conductive gloves as well as non-conductive tools and equipment as a last line of defence, ensuring all such gear is appropriately used and maintained. Protective gloves and other PPE, as well as non-conductive tools, must be re-tested periodically to ensure safety.

Overall, for fleets considering the adoption of electric vehicles (EVs), several factors make them an attractive choice, especially for light-duty vehicles and buses. These include:

- GHG Emissions Reductions: EVs contribute to GHG emissions reductions, promoting environmental sustainability.
- Operational Cost Savings: EVs offer a notable reduction in operational costs by eliminating fuel consumption, providing access to lower-cost electricity, and reducing maintenance.
- Comparatively Lower Charging Infrastructure Costs: Charging infrastructure costs for EVs, particularly direct current fast chargers, are relatively lower than those associated with other fuel-reduction and emission-reducing technologies such as CNG or hydrogen fueling stations.

[107] Source: https://www.recurrentauto.com/research/winter-ev-range-loss
[108] Source: https://www.recurrentauto.com/research/winter-ev-range-loss
[109] Source: https://www.edfenergy.com/electric-cars/batteries
[110] Source: https://www.here.com/learn/blog/ev-battery-recycling#:~:text=Despite%20the%20fact%20that%20up,concerns%20and%20potential%20resource%20wastage.
[111] Source: https://training-ltl.ca/

To facilitate fleet management, the installation of direct current fast chargers (DC fast chargers), or the less expensive Level 2 charger, is recommended. The benefit of the DC fast charger is that it enables quick charging in situations where overnight charging may be impractical or during emergencies. A fleet evaluation to identify suitable vehicles for replacement with EVs is a crucial step. Additionally, addressing any concerns related to range anxiety with remedies such as consistent overnight charging and available chargers throughout the Town will improve BEV adoption by drivers.

Battery electric vehicle market availability

Of the technologies with zero tail-pipe emissions, battery electric technology provides the greatest array of options, as shown in Table 16 and Table 17. The list is not exhaustive, especially for the common vehicle-types such as sedans, pickups, SUVs, and class 8 trucks.

Table 16. Light-duty BEVs available that are viable options for the Town to consider[112]

Current Fleet Vehicle-Type	Electric Replacement Vehicle[112]	Estimated Range (km)	Cargo Space	Estimated Price (excluding incentives) in CAD	Battery Capacity (kWh)	Acceptance Rate (kW)
Pickups	**2023 Ford F-150 Lightning Pro (5,000 lbs of towing)**[113]	385	-	61,395.00	98	19.6
	2023 Ford F-150 Lightning Platinum (8,550 lbs of towing)[114]	485	-	120,875.00	131	19.6
SUVs	**Tesla Model Y**[115]	395	76.2 cu ft (2158 L)	53,990.00	57.5	11.5
	Tesla Model Y Long Range[116]	495	76.2 cu ft (2158 L)	63,990.00	75	11.5
	Hyundai Kona[117]	420	63.7 cu ft	49,0775.00	64	-
Vans	**Ford E-Transit Cargo Van**[118]	200	536.4 cu ft	73,545.00	68	22
	Ford E-Transit Cutaway[119]	200	-	71,050.00	68	22
	Ford E-Transit Chassis Cab[120]	200	-	71,800.00	68	22
Class 2 Buses	**Endera Motors B Series (16 seater)**[121]	215	-	265,000.00	150	225

[112] This list is not exhaustive but provides the most relevant EV options available at the time of the report.
[113] Source: https://shop.ford.ca/configure/f150-lightning/model/customize/pro?gnav=shopnav-bp
[114] Source: https://shop.ford.ca/configure/f150-lightning/config/paint/Config[%7CFord%7CF-150%20Lightning%7C2023%7C1%7C1.%7C710A.W1E..PDR...SS5.CCAB.99V.77P.]?gnav=shopnav-bp
[115] Source: https://www.tesla.com/en_ca/modely/design#overview
[116] Source: https://www.tesla.com/en_ca/modely/design#overview
[117] Source: https://www.hyundaicanada.com/en/shopping-tools/buildandprice/build?step=2&model=2024-kona-electric
[118] Source: https://shop.ford.ca/configure/e-transit/model/customize
[119] Source: https://shop.ford.ca/configure/e-transit/model/customize
[120] Source: https://shop.ford.ca/configure/e-transit/model/customize
[121] Source: https://www.sdge.com/sites/default/files/documents/SDG%26E%20Vehicle%20Availability-February%202022.pdf?pid=21746

There is a large demand for light-duty vehicles, which has resulted in manufacturers providing a variety of options that are available for purchase. Although this partially applies to tractor trailers, the supply of mobile equipment and medium and heavy-duty vehicles is limited.

Table 17. Mobile equipment and medium- and heavy-duty vehicles available that are viable options for the Town to consider

Current Fleet Vehicle-Type	Electric Replacement Vehicle	Estimated Range (km)	Cargo Space	Price (excluding incentives) in CAD	Battery Capacity (kWh)	Acceptance Rate (kW)
Tandem Axle Trucks	**Lion8 (which can be purchased as a tandem truck)[122]**	275	-	575,000.00	336	350
	Tesla Semi[123]	800	-	244,000.00	640	750
Class 5 & 6 Incomplete Trucks	**Lion6[124]**	290	-	325,000.00	252	240
Single Axle Dump Trucks	**International eMV series single axle dump truck[125]**	215	-	503,700.00	250	-
Tandem Axle Flusher & HV607	**Tandem Axle Flusher[126]**	275	-	785,000.00	336	350
Book Mobile	**International eMV series box truck (class 7)[127] + library retrofit[128]**	215	1786 cu ft	480,560.00	250	-
Box Trucks	**International eMV series box truck (class 7) [129]**	215	1786 cu ft	430,560.00	250	-
Class 6 Waste Collection	**BYD Garbage Truck[130]**	125	-	406,165.00	281	200
HD Waste Collection	**Mack LR Electric Truck (Garbage Truck)[131]**	-	-	832,602.00	300	-

[122] Source: https://financialpost.com/commodities/energy/electric-vehicles/lion-electric-ceo-predicts-ottawas-new-ev-truck-subsidy-will-boost-demand#:~:text=The%20subsidy%20offers%20a%20%24100%2C000,retails%20for%20%24550%2C000%20to%20%24600%2C000.
[123] Source: https://www.tesla.com/en_ca/semi
[124] Source: https://financialpost.com/commodities/energy/electric-vehicles/lion-electric-ceo-predicts-ottawas-new-ev-truck-subsidy-will-boost-demand#:~:text=The%20subsidy%20offers%20a%20%24100%2C000,retails%20for%20%24550%2C000%20to%20%24600%2C000.
[125] Source: https://www.truckpaper.com/listing/for-sale/229754005/2023-international-emv-dry-van-trucks-slash-straight-trucks-box-trucks
[126] In the Wasaga Beach fleet, a tandem axle flusher repurchase price was $210K more than the regular tandem axle truck. This calculation was applied to the EV version
[127] Source: https://www.truckpaper.com/listing/for-sale/229754005/2023-international-emv-dry-van-trucks-slash-straight-trucks-box-trucks
[128] Library retrofit was estimated to cost roughly $50,000 by Wasaga Beach
[129] Source: https://www.truckpaper.com/listing/for-sale/229754005/2023-international-emv-dry-van-trucks-slash-straight-trucks-box-trucks
[130] Source: https://en.byd.com/news/press-release-buses-delivery-vans-and-garbage-trucks-are-the-electric-vehicles-next-door/
[131] Source: https://www.miamidade.gov/solidwaste/library/flyers/ev-fact-sheet.pdf

Case Wheel Loaders	**Case 580 EV[132]**	-	-	-	90	-
Street Sweepers	**Battle Motors/Elgin Electric Broom Bear (Street Sweeper)[133]**	-	-	1,080,600.00	400	-
Ice Resurfacer	**Engo Wolf Ice Resurfacer[134]**	-	-	158,250.00	70	13.2
Kubota 7040 w/ M25 loader bucket	**Solectrac e70N[135] w/ M25 loader bucket[136]**	-	-	118,200.00	60	19
Kubota small tractors	**Solectrac e70N[137]**	-	-	101,350.00	60	19
Lawn Mowers	**Lazer Z V-Series[138]**	-	-	54,700.00	23.4	3
UTVs	**2022 Polaris Ranger EV[139]**	-	-	18,510.00	14.9	-

Many BEVs were not mentioned due to having similar specs to other vehicles listed, or having no relevance to the fleet, such as 60-foot BEV buses. In total, over 100 vehicles in the Town's fleet could be replaced by BEVs; however, not all were deemed practical due to low range BEV substitutes such as the 12 – 24 seater BEV buses, reducing the number of converted vehicles to 97. It is important to keep in mind that although not every vehicle, mobile equipment unit, or power tool is available for replacement today, this will most likely change in the medium-term.

Resale Value

Recently, the BEV used vehicle market has seen a rapid decline, from a time when it appeared used BEVs had extremely high resale values. One of the main contributors to this recent decline is most likely the significant rise in interest rates that make large investments, such as in BEVs or the charging infrastructure, less attractive. With interest rates now expected to go gradually go down[140], the variance in the resale market is expected to go down.

Looking into the future, forecasts from Consumer Reports suggest gasoline vehicles and BEVs are expected to depreciate at very similar rates, with gasoline vehicles holding slightly more value over a 5-year time period, 56%, versus BEVs at 55%[141]. Kelley Blue Book, instead of forecasting future

[132] Source: https://www.casece.com/northamerica/en-us/products/backhoe-loaders/580ev-project-zeus
[133] Source: https://battlemotors.com/blogs/news/nation-s-first-all-electric-street-sweeper-comes-to-los-angeles
[134] Source: https://mccac.ca/project-showcase/city-of-calgary-engo-ice-wolf-electric-ice-resurfacers/
[135] Source: https://electrek.co/2021/08/04/solectrac-launches-new-70-hp-60-kwh-electric-tractor-for-75000/#:~:text=The%20Solectrac%20e70N%20costs%20%2474%2C999,to%20deliver%20in%20spring%202022.
[136] Source: https://www.millerloader.com/products/loaders/m-series/m25
[137] Source: https://electrek.co/2021/08/04/solectrac-launches-new-70-hp-60-kwh-electric-tractor-for-75000/#:~:text=The%20Solectrac%20e70N%20costs%20%2474%2C999,to%20deliver%20in%20spring%202022.
[138] Source: https://www.exmark.com/products/mowers/zero-turn/lazer-z/lazer-z-v-series
[139] Source: https://www.jdpower.com/motorcycles/2022/polaris/ranger-ev-avalanche-grey/values
[140] Source: https://altrua.ca/canada-interest-rate-forecast/#:~:text=Historical%20context%3A%20Mortgage%20rates%20will,1%25%20of%20cuts%20in%202024.
[141] Source: https://advocacy.consumerreports.org/wp-content/uploads/2020/10/TCO-Fact-Sheet-Chapter-1-FINAL-1.pdf

depreciation, looked at the depreciation rate over the past 5-years and found EVs have held 37% of their initial value versus ICE vehicles at 46%[142]. Although there has been slightly more rapid depreciation in the past of EVs, this is expected to change as further technological improvements occur in BEVs that prolong their utility and appeal.

Grants and Incentives

BEVs have a wide range of incentives offered by Natural Resources Canada (NRCan), Infrastructure Canada, and Transport Canada. For medium and heavy duty vehicles, Transport Canada offers up to $200,000 in purchase incentives, while offering $5,000 for light-duty vehicles. Infrastructure Canada also offers up to 50% of the cost of a new BEV bus and/or the supporting infrastructure. Meanwhile, NRCan offers 50% off the cost of charging infrastructure for all types of battery electric vehicles. Please see Appendix E for the table of applicable incentives for the Town's fleet.

Total Cost of Ownership

Due the higher upfront cost of BEVs but low cost of electricity and maintenance, the technology's value proposition improves when the vehicle travels long distances. Therefore, the Town's average annual mileage of heavy-duty vehicles of less than 9,000 km is disadvantageous when comparing the technology to traditional diesel trucks. BEVs were compared in the Deloitte Total Cost of Ownership Tool for class 6, 7, and 8 trucks with assumptions based on the Town. The following are the assumptions used to calculate the total cost of ownership:

Table 18. Assumptions for the total cost of ownership calculation for BEV and diesel class 6, 7, and 8 trucks

BEV Total Cost of Ownership Assumptions	Diesel Total Cost of Ownership Assumptions
Purchasing Costs: • ***Vehicle Price = $350,000***[143] • ***Vehicle Incentives = $150,000***[144] • ***Loan Term = 5 years***[145] • ***Interest Rate = 8%***[146] • ***Ownership Period = 14 years***[147]	**Purchasing Costs:** • *Vehicle Price = $200,000*[148] • *Loan Term = 5 years*[149] • *Interest Rate = 8%*[150] • *Ownership Period = 14 years*[151]
Fuel Costs: • ***Electricity Price (Off-Peak) = $0.087/kWh***[152]	**Fuel Costs:** • *Fuel Price = $1.65/L*[155] • *Mileage = 8,907 km*[156]

[142] Source: https://www.cnbc.com/2023/05/21/what-to-know-about-buying-a-used-ev-as-more-hit-the-car-market.html
[143] Approximation based on the Tesla Semi Short-Range ($200K), Tesla Semi Long-Range ($250K), Lion6 ($300K - $350K), and the Lion8T ($550K - $600K)
[144] Source: https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/medium-heavy-duty-zero-emission-vehicles/imhzev-eligible-vehicles
[145] Source: https://www.mortgagecalculator.org/calcs/truck.php#:~:text=The%20average%20life%20of%20a,have%20less%20inherent%20collateral%20value.
[146] Source: https://smarter.loans/truck-loans/
[147] Based on the recommended lifecycles from the LCA analysis of class 8 trucks in Appendix A
[148] Source: https://www.durabakcompany.com/blogs/durabak/how-much-does-a-semi-truck-cost
[149]Source: https://www.mortgagecalculator.org/calcs/truck.php#:~:text=The%20average%20life%20of%20a,have%20less%20inherent%20collateral%20value.
[150] Source: https://smarter.loans/truck-loans/
[151] Based on the recommended lifecycles from the LCA analysis of class 8 trucks in Appendix A
[152] Source: https://wasagadist.ca/accounts-and-billing/rates/time-of-use/#:~:text=OFF%2DPEAK%20%E2%80%93%208.7%E2%82%B5%20%2F,When%20electricity%20demand%20is%20lowest.
[155] Source: https://www.gasbuddy.com/gasprices/ontario/wasaga-beach
[156] Wasaga Beach average annual heavy-duty mileage

• ***Fuel Efficiency = 0.91 km/kWh***[153] • ***Mileage = 8,907 km***[154] • ***Number of Fueling Stations = 0***	• *Fuel Efficiency = 2.86 km/L*[157]
Non-energy Operating Costs: • ***Insurance = $12,000 (value is not publicly available and was made equivalent to the diesel vehicle to ensure comparability)*** • ***Repairs & Maintenance = $6,100/year***[158]	**Non-energy Operating Costs:** • *Insurance = $12,000*[159,160] • *Repairs & Maintenance = $9,450/year*[161]

The result was a total cost of ownership of approximately $74,000 less over the lifetime of the truck if a BEV truck is purchased compared to a diesel truck, as seen in Figure 22.

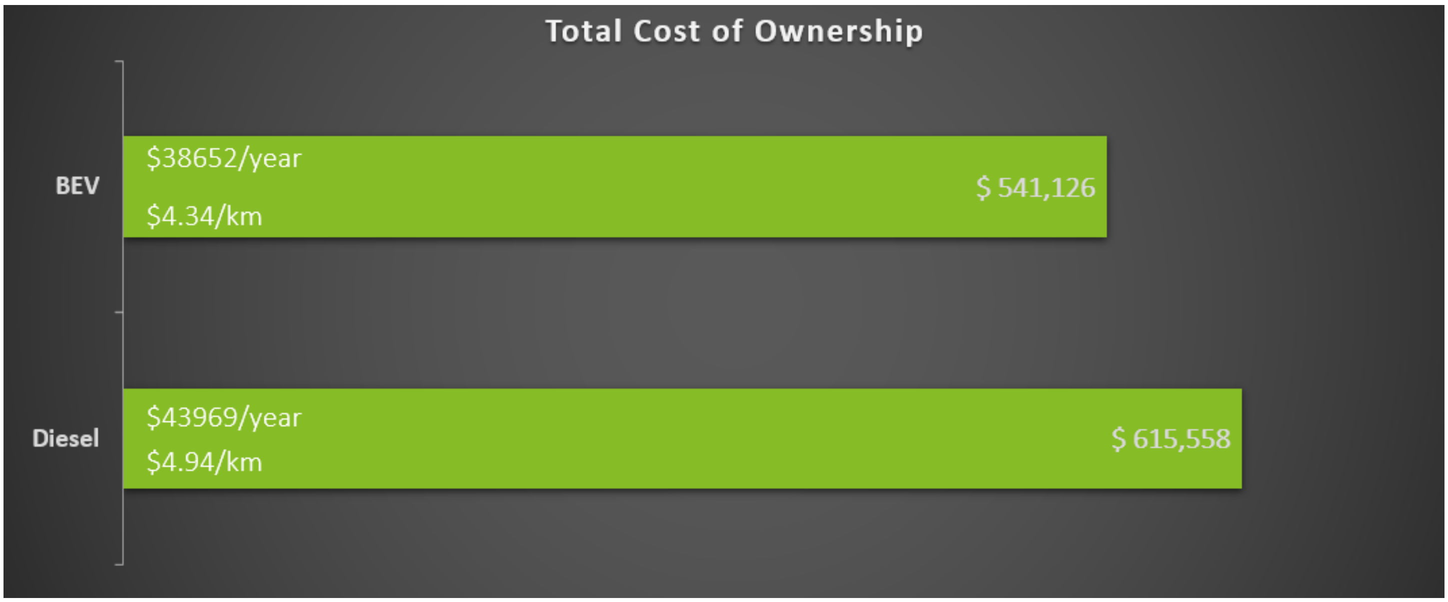

Figure 22. Battery electric total cost of ownership versus the conventional diesel vehicle for heavy-duty trucks, assuming inputs tailored to the Town's fleet

To ensure a successful implementation, proactive measures and stakeholder engagement are crucial. This involves collaborating with government entities, industry experts, infrastructure providers, and end-users. By involving stakeholders, a comprehensive understanding of challenges and requirements can be gained, leading to effective strategies and solutions. This collaboration fosters ownership, collective responsibility, knowledge sharing, and continuous improvement, facilitating a smooth transition and

[153] Source: https://www.volvotrucks.com/en-en/news-stories/press-releases/2022/jan/volvos-heavy-duty-electric-truck-is-put-to-the-test-excels-in-both-range-and-energy-efficiency.html
[154] Wasaga Beach average annual heavy-duty mileage
[157] Source: https://natural-resources.canada.ca/energy/efficiency/transportation/commercial-vehicles/reports/7607
[158] Source: https://www.nrel.gov/docs/fy22osti/82081.pdf
[159] Source: https://lethbridgeinjurylawyer.ca/commercial-truck-insurance-cost-alberta/
[160] Source: https://insurancehero.ca/transportation-insurance/
[161] Source: https://www.nrel.gov/docs/fy22osti/82081.pdf

widespread acceptance of BEVs. Overall, addressing concerns and engaging stakeholders are vital for a successful BEV adoption.

Understanding Plug-in Hybrid Electric Technology

There are many similarities between plug-in hybrids (PHEVs) and BEVs, including safety considerations, battery replacement, and charging considerations. It is worth noting though that Level 3 chargers are not likely a good purchasing decision for PHEV owners, as hybrids typically have small batteries and are not reliant on just their battery. Several key topics do differ between BEVs and PHEVs, such as emissions, impact of temperature on performance, available vehicles in the market, grants, and cost of ownership.

Emissions

PHEVs generally have a battery range between 20 and 40 miles (32 and 64 kilometers)[162], meaning that if a PHEV is charged overnight to full and is then operating in good weather conditions without idling, the first approximately 50 kilometers are emission-free. Due to the Town of Wasaga Beach having two hybrid SUVs with fuel efficiency that vary drastically (5.34 L/100km and 25.67 L/100km), studies on general emission reductions from fleets that have adopted PHEVs was utilized. In Europe, privately owned PHEVs consumed 4.0-4.4 L/100 km, while for company cars, it was 7.6-8.4 L/100 km[163]. This is compared to the average car consuming 9.7 L/100 km in the United States[164]. Assuming fuel consumption of a company plug-in hybrid car is similar to if the Town was to utilize a full fleet of plug-in hybrids, emissions would be expected to reduce by approximately 20%. Although this could improve with overnight charging every night, it may also require a reduction in daily driving, which is not a desired outcome from the Green Fleet Strategy.

Impact of Temperature on Performance

Extreme temperatures in Canada impact plug-in hybrid electric vehicle range due to auxiliary heating for both the vehicle cabin and battery. PHEV owners can mitigate temperature effects by pre-conditioning their vehicle and keeping it plugged in during extreme temperatures. This approach helps maintain battery temperature control and extends battery life[165]. PHEVs can expect declines in fuel economy in cold weather according to the Department of Energy[166], as illustrated in Table 19.

Table 19. Decline in range of gasoline, hybrid, and electric vehicles in cold weather (-7°C) relative to warm weather (25°C)

Vehicle-Type	Change in Fuel Economy (MPG or MPG-equivalent) on Short Trips
Gasoline	15% to 33% decline
Hybrid	25% to 45% decline
Electric	39% decline
Electric (without cabin heat running)	12% decline

Due to auxiliary heating, PHEVs range can change drastically in cold weather, and should be accounted for before long trips. Also, it is worth noting that hybrids reduction in fuel economy is similar to an electric vehicles, although they may perform slightly better due to their combustion engine component.

[162] Source: https://www.consumerreports.org/cars/hybrids-evs/is-a-plug-in-hybrid-vehicle-right-for-you-a9339147016/#:~:text=PLUG%2DIN%20HYBRIDS%20(PHEVs),for%2020%20to%2040%20miles.
[163] Source: https://theicct.org/wp-content/uploads/2022/06/real-world-phev-use-jun22.pdf
[164] Source: https://afdc.energy.gov/data/10310
[165] Source: https://www.geotab.com/blog/ev-range/
[166] Source: https://www.energy.gov/energysaver/fuel-economy-cold-weather

Market Scan

Similar to the electric vehicle market, the plug-in market is evolving with few options, especially in the medium and heavy-duty vehicle segments. As well as this, electric ranges appear to be low within the SUV segment. This is highlighted by the Hyundai Tucson Ultimate PHEV[167] which has an electric range of 53 km (priced at $50,000), or the Ford Escape hybrid[168] with a range of 60 km (priced at $57,000). The pick PHEV market does show more promise in terms of electric range but is priced similarly to electric pickups. For example, the Ram 1500 Ramcharger PHEV (Tungsten option) is priced at approximately $106,000, with an electric range of 233 km.

Grants and Incentives

PHEVs are offered several grants and incentives by different government agencies, although not as many as BEVs or FCEVS. Transport Canada offers up to $200,000 in purchase incentives, while offering $5,000 for light-duty vehicles. Meanwhile, NRCan offers 50% off the cost of charging infrastructure. Unlike for BEVs, Infrastructure Canada does not offer any incentives for hybrid buses and/or the supporting infrastructure. Please see Appendix E for the table of applicable incentives for the Town's fleet.

Cost of Ownership

Given the similar pricing, but greater fuel and maintenance costs, the total cost of ownership is expected to be higher for PHEVs. This is also reflected in the International Energy Agency's total cost of ownership calculator[169]. In the calculator, assuming a PHEV uses their battery 20% of the time and inputting f the Town's fuel cost, electricity cost, and average light-duty annual mileage, the calculator reflects a plug-in hybrid pickup has an ownership cost of $3,000 more than a BEV pickup.

Building the Green Fleet Strategy

The Green Fleet Strategy builds off the Manually Balanced Lifecycle Model by adopting the replacement schedule from the model but exchanging the replacement vehicles of eligible diesel, gasoline, and propane vehicles (i.e., the ice resurfacer) with battery electric vehicles.

Converting the Fleet to Battery Electric Vehicles

The eligibility of a vehicle to replace a current fleet vehicle is dependent on several factors, beginning with its availability in Ontario. If the replacement vehicle impedes the worker's capacity to do their job by reducing their available time with the vehicle, reducing required towing, or reducing required cabin space, then it is considered as ineligible to replace the current model in the fleet. Another factor that was considered was mileage. Several vehicles, such as four transit buses not good candidates for BEV replacement in the fleet due to having annual mileages above 80,000 km. With mileages this high, the daily distance traveled is above 300 km[170], which may require mid-day charging. Due to this impedance in operations for the buses, they did not have planned electric replacements. It is recommended though that if daily mileages decrease for buses, or if available electric bus ranges increase, that BEV replacements are considered in the future by the Town.

The result of these BEV replacement vehicles in the model is an increase in annual CAPEX relative to the Manually Balanced Capital Budget Model of approximately $510,000, but a decrease in annual CAPEX relative to the Business-as-Usual (BAU) Model of $230,000 (see Figure 23). Notably, if available

[167] Source: https://www.hyundaiusa.com/us/en/vehicles/tucson-plug-in-hybrid#:~:text=33%2Dmile%20All%2DElectric%20Range,pack%20and%2080%20combined%20MPGe.
[168] Source: https://www.caranddriver.com/ford/escape
[169] Source: https://www.iea.org/data-and-statistics/data-tools/electric-vehicles-total-cost-of-ownership-tool
[170] Assuming 261 days of operation for the buses

grants and incentives were considered in the Green Fleet Strategy, average annual CAPEX would most likely be reduced by a material amount.

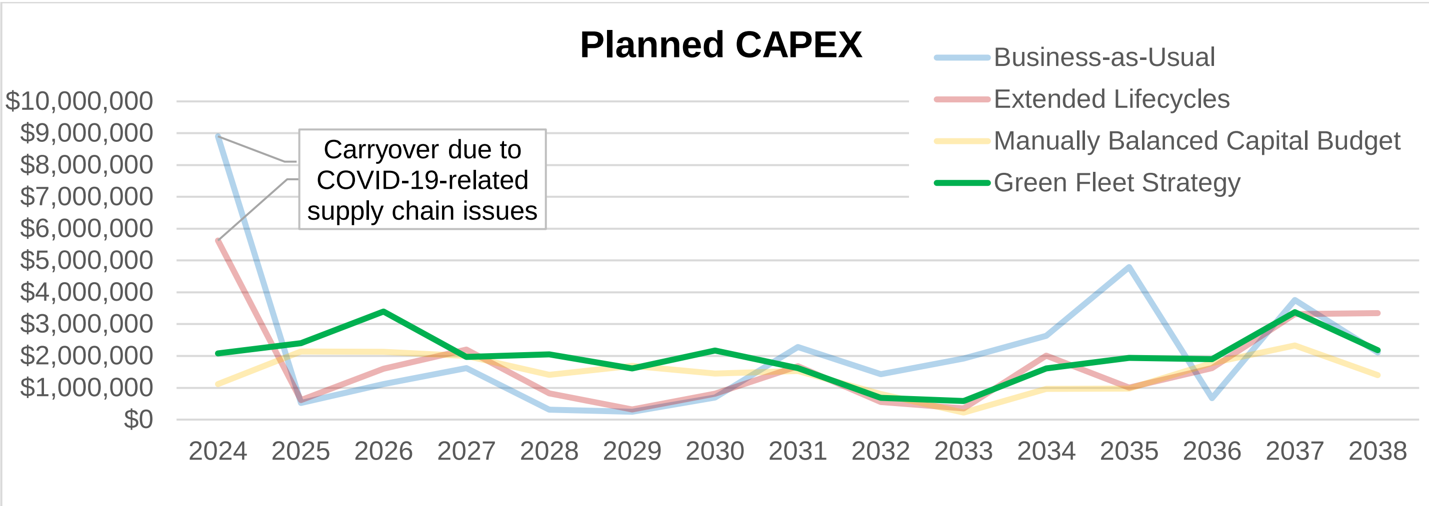

Figure 23. CAPEX of the Green Fleet Strategy Model relative to the previous models

Regarding operating expenditure, the Green Fleet Strategy results in a decrease in annual OPEX relative to the Manually Balanced Capital Budget Model of approximately $180,000, but an increase in annual OPEX relative to the BAU Model of $200,000 (see Figure 24).

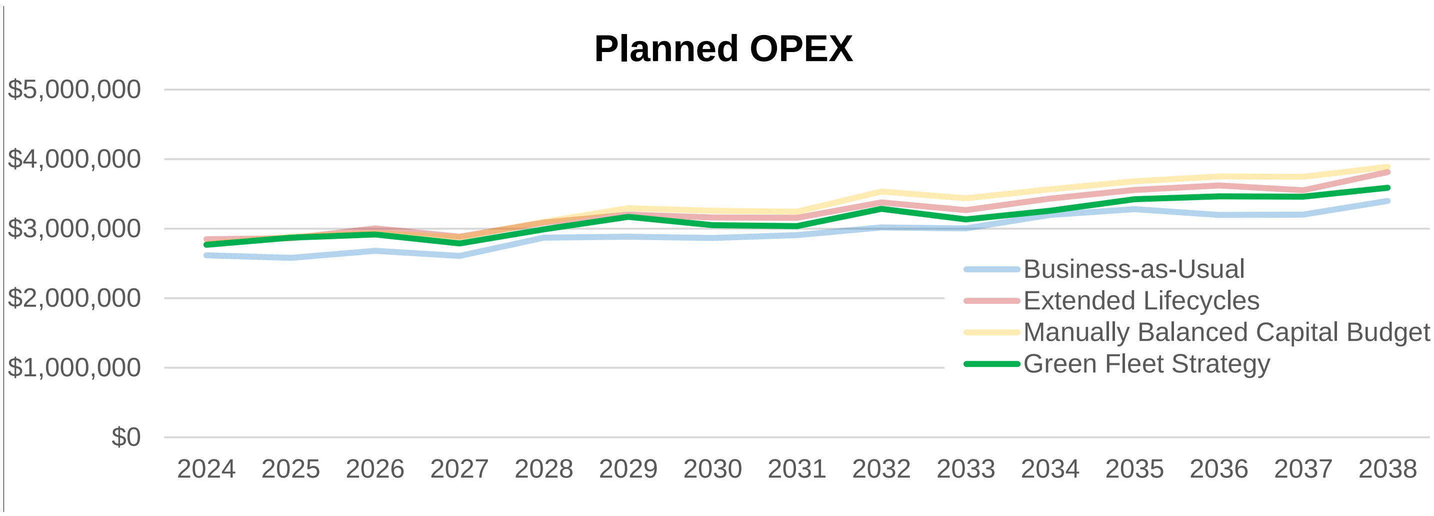

Figure 24. OPEX of the Green Fleet Strategy Model relative to the previous models

Intuitively, tail-pipe emissions reduced dramatically with the replacement of 97 fleet vehicles with BEVs. Over the span of 15 years, the Green Fleet Strategy is expected to reduce tail-pipe emissions by over 60% from a base year of 2023, while the other models' emissions remain relatively static (see Figure 25).

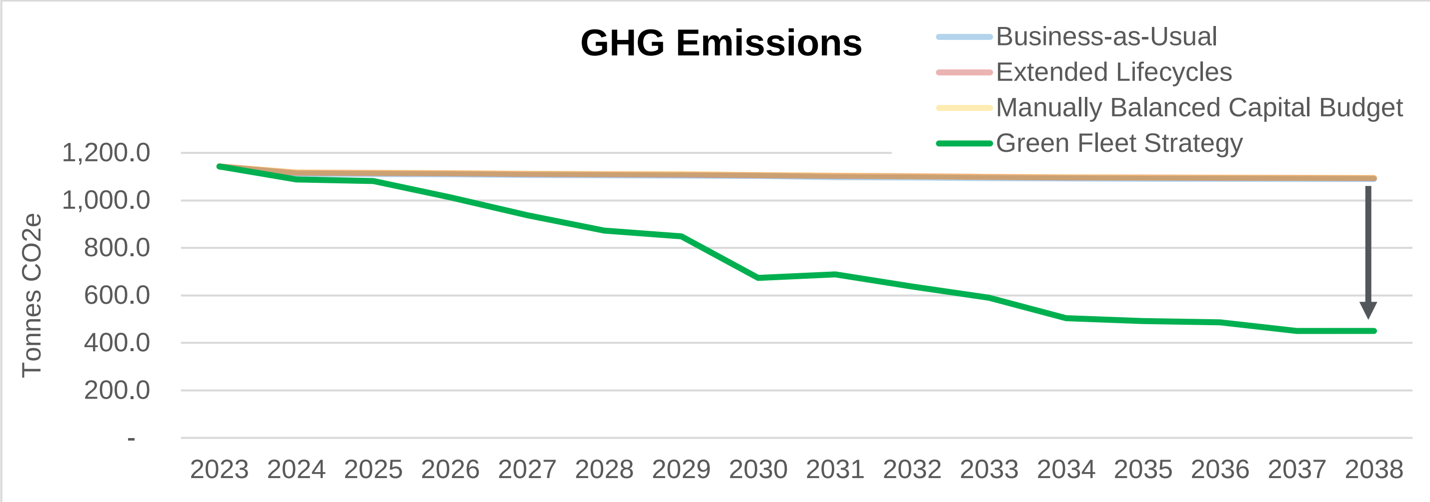

Figure 25. GHG emissions of the Green Fleet Strategy Model relative to the previous models

Below are highlights of the Manually Balanced Capital Budget Model and the impacts of implementing the increased lifecycles:

To compare the Green Fleet Strategy to the other models, key outputs were collected, such as CAPEX, OPEX, and GHG emissions (see Table 20). The Manually Balanced Capital Budget Model was the best plan for minimizing average annual net expenses, with the net expenses being approximately $4.80M a year. Worth noting, the Green Fleet Strategy, although having net expenses per year of $5.12M, does not account for the significant incentives available for BEVs, or the decreasing cost of electric vehicles through time[171].

Table 20. Summary of key outputs from all four models

	BAU Model	Extended Lifecycle	Manually Balanced Capital Budget	Green Fleet Strategy[172]
Average Annual CAPEX	$2.20M	$1.73M	$1.46M	$1.97M
Average Annual OPEX	$2.95M	$3.26M	$3.33M	$3.15M
Average Annual Net Expenses (CAPEX and OPEX)	$5.15M	$4.99M	$4.79M	$5.12M
2038 GHG Emissions (MT CO2e)	1,090.1	1,093.6	1,094.9	450.4

[171] Source: https://www.bls.gov/opub/btn/volume-12/charging-into-the-future-the-transition-to-electric-vehicles.htm
[172] Does not account for any grants or incentives for the purchase of electric vehicles

Implementation Plan and Recommendations

In order to implement the Green Fleet Strategy, a comprehensive plan on how and where charging infrastructure will be installed is required. This was completed in the Electric Vehicle Supply Equipment (EVSE) assessment, which outputs a charging schedule for all Town of Wasaga Beach fleet locations.

Electric Vehicle Supply Equipment (EVSE) Assessment

Current-State of the Town's Charging Infrastructure

The Town of Wasaga Beach has made some strides in advancing its electric vehicle charging infrastructure in public spaces, reflecting a commitment to sustainable transportation. Below are the most recent charging installations and their implications for the hydro capacity and electrification strategy:

1. ***Oakview Woods / Rec Plex (724 Mosley Street)*** *– Level 3: This DC fast charger networked pedestal charging station is a substantial upgrade capable of quick charging sessions. Its installation required an electrical panel extension, EVSE signage, pavement markings, and associated civil and electrical work. The total investment for this site amounts to $75,499.00 excluding HST.*
2. ***Town Hall (30 Lewis Street)*** *- Level 2: Matching the needs of both municipal vehicles and public use, a Level 2 station was installed with an expenditure of $22,953.00 excluding HST.*
3. ***Nancy Lot (137 Mosley Street)*** *- Level 2: This installation serves as another step towards extensive EV infrastructure, costing $22,953.00 before tax.*
4. ***Sports Park (1888 Klondike Park Road)*** *- Level 2: The sports park's EV charging facility required a similar investment to other Level 2 installations, with the cost totaling $22,953.00 excluding HST.*

The total investment for these chargers is approximately $176,700.00, with additional costs for installation ($1,650.00) and annual fees for global management services ($1,050.00) and warranty ($2,710.00). Incentives and grants provided to the Town for the charger installations are not included in these dollar values.

The integration of these chargers requires careful consideration of the current hydro capacity of their respective locations. The fast charger at Oakview Woods/Rec Plex, in particular, demands a higher power output. Each Level 2 charger, while less demanding than the fast charger, adds to the cumulative load on the municipal grid and the locations' electrical capacity.

Going forward, it is recommended that the Town continues to monitor usage patterns and electrical loads to optimize the operation and expansion of EV charging facilities. This proactive approach will enable the Town to manage the transition towards an electrified future effectively.

Due to the aforementioned charging stations being public sources of charging, the Town is unable to rely on them for fleet vehicle charging, especially as the community becomes more reliant on them. Due to this fact, the Town has requested that the charging infrastructure schedule in the Green Fleet Strategy does not consider them as a source of charging and future installations are to be specifically allocated for fleet vehicle and mobile equipment charging.

Potential Neighbouring Town Charging Partnerships

Due to major logistical constraints when charging infrastructure is in another town or township, partnering with a neighbouring town was deemed to be infeasible. More specifically, the placement of charging stations would be inefficient for the Town of Wasaga Beach if the charger was located elsewhere. This would require the driver to begin and end their day in another town or drive long distances mid-day. The driver would also have to account for this extra mileage to ensure the vehicle has the charge required to get to the charging station.

If future opportunities arise where these constraints are mitigated, it is recommended that the Town considers not only the advantages of decreasing the operating and capital expenditure that comes with shared charging locations, but also the disadvantages. This includes, but is not limited to, usage policies and access management, agreeing on the type of charger that is most cost effective and compatible with both fleets, and the long-term commitment to out-of-town charging.

Green Fleet Strategy Charger Timeline

Designing an effective EV charging infrastructure for a town involves considering various factors, including the number of vehicles, geographic spread, and population size. The Electric Vehicle Supply Equipment (EVSE) (charging) analysis tool includes programmable and automated formulas for determining charging requirements on a unit-by-unit basis. The tool:

- *Is based on the results of the Green Fleet Strategy Model, as the EVSE tool phases in charging stations as the vehicles that require them are purchased.*
- *Is based on each unit having access to a charger every night during off-peak hours (7 pm-7 am).*
- *Is based on a rate of inflation of 2.0%.*
- *Allows programmable upper and lower estimates of range that can be adjusted in consideration of heating/cooling in cold- or hot-weather conditions as well as on-board electrical accessories.*
- *Calculates the daily charging time required to return to near-full charge for vehicles of all classes by allowing for estimates of EV battery capacity, charger current, and charger voltage. This assumes that the charge is empty when beginning the charge.*
- *Calculates the cost to charge the fleet, assuming all units will charge each night during off-peak hours.*
- *Allows programmable acquisition costs for chargers (or chargers plus infrastructure) for each unit. The costs were estimated at $17,130 for a Level 2 charger[173] and $99,800 for a Level 3 charger[174].*
- *Return-to-base battery levels are based on a starting charge of 90%, as a best practice for optimizing battery life.*
- *Specifies the location of the chargers to be installed.*

The inputs selected within the EVSE tool are based on various estimates regarding charging levels and battery capacity for different unit types. The inputs utilized are approximations derived from the specifications available online and a “best-case” and “worst-case” scenarios were prepared based on expected battery life and range. Based on the charging demand of all units, the results show that 88 Level 2 and 9 Level 3 chargers would be needed, on a phased-in basis, as BEVs are acquired by the Town each year. Before committing to installing Level 3 chargers, it is crucial to take a strategic approach and consider that many of the EVs would likely be adequately charged with a level of charging between low-power Level 2 and Level 3 if they each have access to a charger every night. The total cost of Level 2 and Level 3 EV chargers for the 15 years between 2024 and 2038 is estimated at $2.7M, or an average of $180,000 per year. When considering installations solely at locations directly controlled and operated by the Town (Fire Hall – Station 1, Rec Plex, Twin Pad Arena, Sports Park, Operations Yard, and Town Hall), the estimated cost over 15 years is $2.4M, or an average of $160,000 per year.

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[173] Based on Wasaga’s past L2 charging projects’ supply costs and installation/trenching costs, on a per charger basis (rather than on a per dual pedestal basis)
[174] Based on the price of a FLO SMART DC 100kW charger supplied by Honda E Quipt, plus the installation/trenching costs that Wasaga incurred on their previous L3 charger

For the next 10-15 years, if budget permits, it is recommended that capital is allocated towards charging infrastructure required for the transition to EVs for all vehicle categories, with a focus on lighter-duty units (pickups) in the short term. If the opportunity arises, it is also recommended that the Town considers having pairs of low mileage vehicles at the same location take turns using chargers at night to save on charger equipment and installation costs. Much of the additional capital costs associated with electric vehicle supply equipment (EVSE) may be offset through lower operating costs (fuel and maintenance savings). Importantly, existing electrical capacity at facilities may require upgrades to power charging stations for multiple vehicles, which may add to the estimated costs presented in the analysis. Table 21 presents costs estimates by each year between 2024 and 2038.

Table 21: EVSE outlook for on-road units for all Wasaga Beach locations[175]

Year # of BEV Phase-in Plan	Year of BEV Phase-in	L2 Chargers Added to Fleet (per EVSE phase-in plan)	L3 Chargers Added to Fleet (per EVSE phase-in plan)	Estimated Cost per L2 Charger plus Infrastructure (including inflation)	Estimated Cost per L3 Charger plus Infrastructure (including inflation)	Cost of Chargers plus Infrastructure
1	2024	8	0	$ 17,130	$ 99,800	$137,040
2	2025	4	0	$ 17,473	$ 101,796	$69,890
3	2026	6	3	$ 17,822	$ 103,832	$418,428
4	2027	6	2	$ 18,178	$ 105,909	$320,888
5	2028	9	2	$ 18,542	$ 108,027	$382,932
6	2029	3	0	$ 18,913	$ 110,187	$56,739
7	2030	13	0	$ 19,291	$ 112,391	$250,785
8	2031	6	0	$ 19,677	$ 114,639	$118,062
9	2032	6	0	$ 20,071	$ 116,932	$120,423
10	2033	8	0	$ 20,472	$ 119,270	$163,775
11	2034	7	1	$ 20,881	$ 121,656	$267,825
12	2035	6	0	$ 21,299	$ 124,089	$127,794
13	2036	1	0	$ 21,725	$ 126,571	$21,725
14	2037	3	1	$ 22,159	$ 129,102	$195,580
15	2038	2	0	$ 22,603	$ 131,684	$45,205
Averages		5.9	0.6	$19,749	$115,059	$179,806
Totals		88	9			$2,697,093

Green Fleet Strategy Charger Installation Schedule

More granularly, the schedule for Level 2 and Level 3 chargers is shown in Table 22 and Table 23. Having schedules for specific locations is essential not only for planning purposes but for determining the additional electrical capacity required per location.

[175] When considering installations solely at locations directly controlled and operated by the Town—such as Fire Hall Station 1, Rec Plex, Twin Pad Arena, Sports Park, Operations Yard, and Town Hall—the estimated cost over the 15-year period decreases from $2.7M to $2.4M.

Table 22: Level 2 and Level 3 installation schedule for each Wasaga Beach location

	Fire Hall - Station 1		Rec Plex		Twin Pad Arena		Sports Park	
	L2 Chargers	L3 Chargers	L2 Chargers	L3 Chargers	L2 Chargers	L3 Chargers	L2 Chargers	L3 Chargers
2024			1		1			
2025			1		2			
2026			1				2	
2027			1				1	
2028	1				1		2	
2029							1	
2030	1				1		2	
2031								
2032							3	
2033	1		1				1	
2034	1						1	
2035								
2036								
2037							1	
2038							2	
Total	4	0	5	0	5	0	16	0

The largest locations, the Operations Yard and Town Hall, will require 32 and 36 parking spots, respectively, by the end of 2028. It is also worth noting that there are two locations, the Landmark Bus Lines and Wasaga Distribution, that the Town do not have direct control over. Therefore, it is unclear who would be purchasing the charging infrastructure, as well as the policy surrounding using those locations' chargers.

Table 23: Level 2 and Level 3 installation schedule for Town locations, as well as greyed columns representing locations not directly controlled by the Town

	Operations Yard		Town Hall		Colingwood Yard		Wasaga Distribution / Hydro	
	L2 Chargers	L3 Chargers	L2 Chargers	L3 Chargers	L2 Chargers	L3 Chargers	L2 Chargers	L3 Chargers
2024	5		1					
2025	1							
2026	2	3					1	
2027	3	2					1	
2028	1	2	2				2	
2029	1		1					
2030	4		3				2	
2031	3		1		1		1	
2032	2						1	
2033	3		1				1	
2034	5							1
2035	4		2					
2036							1	
2037	2	1						
2038								
Total	36	8	11	0	1	0	10	1

First Steps

The first year of the Green Fleet Strategy (2024) requires eight L2 charger installations. *Evolute Power* recommends the installation of Core+ 7.2 kW FLO chargers instead of installing 19.2 kW chargers. This is to allow for more L2 charger installations at each site. For example, according to *Evolute Power*, there is available capacity for 22, 7.2 kW CoRe L2 charging stations at the Operations Yard. If 19.2 kW CoReMAX chargers were installed instead, only 6, L2 chargers could be installed before a service upgrade is required at the site.

The quote provided by *Evolute Power* in Appendix G is for five 19.2 kW chargers installed at the Operation Yard, one 19.2 kW charger installed at the Rec Plex, and one 19.2 kW charger installed at the Town Hall. *Evolute Power* only quoted seven installations (instead of the eight required in 2024 according to the Green Fleet Strategy) due to the unknown charging location of one of the eight vehicles, which is assumed to be at the Twin Pad Arena in Table 22[176]. The cost of installation at the Twin Pad Arena can be assumed to be similar to the installation cost for one charger at the Town Hall and Rec Plex ($29,905 plus tax and $37,175 plus tax, respectively).

Including trenching and electrical room material costs, the cost for all eight first year installations is approximately $225,000 plus tax (not including incentives)[177]. This is a rough approximation of the installation costs required, although, if 7.2 kW chargers were installed instead, this cost would decline.

Electrical Capacity Site Assessments

Evolute Power visited the Operations Yard, Rec Plex, Sports Park, Town Hall, and Fire Hall 1 to determine the current available electrical capacity at each site and determine the number of chargers that can be installed before a service upgrade is required. *Evolute Power*, as previously described, also provided estimates of the installation costs required in 2024 according to the replacement schedule within the Green Fleet Strategy.

Appendix G contains a breakdown of all the building capacity reports that *Evolute Power* delivered to the Town. The goal of these reports were to highlight the available electrical capacity at each location and determine the maximum number of L2 and/or L3 charging stations that can be installed before a service upgrade is required. Evolute Power's findings can be shown in Table 24, with further information available in Appendix G.

Table 24: Number of 7.2 kW chargers that may be installed prior to a service upgrade at each location

Location	Number of 7.2 kW chargers that may be installed prior to a service upgrade
Operations Yard	22
Rec Plex	74
Sports Park	21
Town Hall	10
Fire Hall 1	15

[176] This vehicle was originally located at the Transit Building according to data provided by the Town. Since the Transit Building was recently demolished, Deloitte was advised to allocate the vehicle to the Twin Pad Arena.
[177] A summation of the 2024 estimates in Appendix G while additionally including the cost for the Twin Pad Arena, which is assumed to be $35,000 based on the installation cost for one charger at the Town Hall and Rec Plex ($29,905 plus tax and $37,175 plus tax, respectively).

Notably, *Evolute Power* states that service upgrades take approximately one year, with costs varying drastically depending on the utility[178]. Please see Appendix G for each site's existing electrical system capacity, as well as their demand load relative to total available power.

Recommendations

After a thorough examination of the Town's operations and insightful interviews and surveys, it is evident that the current practices are commendable. However, to optimize operations further and align with best practices, the proposed recommendations aim to enhance efficiency, fill operational gaps, and contribute to the overall satisfaction of staff. These measures are designed to build upon existing strengths, ensuring a structured and streamlined approach to the Town's operations during the green fleet transition.

After identifying areas for improvement and acquiring valuable insights, the key recommendations were categorized, prioritized, and accompanied by estimated timeframes (see Table 25). This plan aims to address immediate needs and lay the foundation for sustained improvement.

The following table encapsulates pivotal recommendations outlined in the report, providing a concise overview of strategic measures to enhance the Town of Wasaga Beach's fleet operations during the electric transition. The implementation timeframe is divided into two segments: short-term (0-5 years) and medium-term (6-10 years). Priorities are assessed on a scale of 1 - 4, with 4 indicating the highest importance and significance.

Table 25. Recommendations and implementation timeframes

Topics	Key Recommendations	Implementation Timeframe	Priority (1-4)
Asset management and Specifications	*1) Refine and update vehicle lifecycles based on the outcomes of the lifecycle Assessment (LCA) and policies best practices.*	Short-term	**4**
	2) Consider recommended manual CAPEX balancing based on established condition ratings to assess vehicle and equipment conditions effectively.	Short/Medium-term	**3**
	3) Efficiently manage the utilization of the fleet, ensuring that vehicles are utilized optimally and aligned with operational requirements.	Medium-term	**2**
	4) Right-size the fleet by matching vehicles precisely to job requirements, promoting cost-effectiveness and operational efficiency.	Short-term	**2**
	5) Install chargers at specific locations according to the EVSE installation schedule. Take into account the level of the charger and whether it is power sharing to ensure optimal charge rates.	Short/Medium-term	**4**

[178] According to Evolute Power service upgrade costs are not publicly available and are highly dependent on the location and transformer. Accurate estimates would require inquiries from the Town to Wasaga Distribution.

	6) *Consider creating a log of condition rating of vehicles should be kept by the Fleet Manager and updated annually. For higher annual mileage vehicles in the fleet, it is recommended that the Town reviews the condition of high mileage vehicles at thresholds of 20,000 km/yr for light-duty vehicles (LDVs) and 25,000 km/yr for medium- and heavy-duty vehicles (MHDVs) for potential early replacement.*	Short-term	**2**
	7) *The Town continues to purchase vehicles, rather than lease or rent vehicles.*	Medium-term	**1**
Financial	1) *Consider issuing monthly departmental fuel and GHG emission reports to empower managers in increasing the fuel efficiency of their assigned vehicles, reducing consumption, and associated emissions.*	Medium-term	**1**
Green Fleet Strategy	1) *Establish clear and measurable sustainability goals with specific KPIs, including targets like reducing carbon emissions (using the Green Fleet Strategy forecasted emissions as a guideline, depending on the Town's level of implementation), achieving a participation rate of x% in driver training programs for fuel-efficient driving, and increasing the use of alternative fuels to constitute x% of the total fuel consumption.*	Short-term	**2**
	2) *Gradually commence the fleet transition with a pilot program that emphasizes monitoring performance through telematics, collecting driver feedback, and assess the integration of BEVs into daily operations.*	Short-term (*quick win)	**4**
	3) *Explore funding opportunities provided by NRCan's Zero Emission Vehicle Infrastructure Program (ZEVIP), Infrastructure Canada's Zero Emission Transit Fund, Transport Canada's Incentives for Medium- and Heavy-Duty Zero Emission Vehicles Program (iMHZEV), and other grants and incentives listed in the report.*	Short-term (*quick win)	**4**
	4) *As a short-term solution for GHG emission reduction, explore the use of biodiesel, invest in idling-reduction technologies and explore the use of eco-friendly shop practices.*	Short-term	**1**
	5) *Electric buses should be considered in the future if daily mileages of the Town's buses decrease or if*	Medium-term	**3**

	electric buses available to be purchased increase in range. 6) *If operationally possible, consider having pairs of low mileage vehicles at the same location take turns using chargers at night to save on charger equipment and installation costs.*	Short-term	**1**

Moving forward, the Town's focus should shift to the high priority recommendations. However, to yield quick and tangible improvements to the fleet, some "quick wins" have been identified in Table 25. These initiatives are swiftly implementable with minimal effort, and potentially offer immediate benefits. For example, exploring grants and incentives that are available to the fleet can have material impacts on purchasing decisions. By addressing these aspects, immediate improvements can be made, fostering enhanced clarity on the effectiveness of the Green Fleet Strategy, cost-effectiveness, and overall operational excellence.

Appendix

Appendix A: LCA

a) Approach

A Lifecycle Assessment (LCA) is a structured approach to determine the best time to replace vehicles and equipment in terms of age, mileage, or other pertinent factors. LCA provides empirical justification for replacement policies and facilitates the analysis and communication of future replacement costs. LCA identifies capital strategies that will optimize vehicle lifecycles and return-on-investment (ROI). LCA should be the first step in long-term capital budget planning (LTCP).

LCA illustrates the total lifecycle cost of fleet vehicle types/categories. LCA can help determine: the age at which units should be considered for replacement; and when replacement should occur, ideally before costs rise and reliability/safety is reduced, and before capital expenditure or refurbishment is necessary.

As shown in Figure 26, fleet management is a complex juggling act. Capital investment, operating expenses, depreciation, preventive maintenance levels, fuel consumption, aging of the fleet, availability, utilization, emissions, and inflation are interconnected issues. Making a change to any one of these critical considerations impacts all of them.

Figure 26. Fleet management roles and responsibilities

For example, deferred capital spending will result in an aging fleet, in turn resulting in higher reactive repair rates, more downtime, higher fuel consumption, increased operating costs, and, ultimately, a larger overall fleet size to allow for more spare vehicles to compensate for the reduced reliability of primary vehicles. Counter to this, if vehicles are replaced too soon, value may be lost.

The key to success is knowing the optimal economic lifecycle for each type of vehicle in a fleet. With that information, fleet managers can balance their go-forward capital spending to align with service level (uptime) and operating expenses (OPEX), and other essential success measures. **Figure 27** depicts the concept of LCA. As a vehicle's age at retirement increases, ownership costs decrease, and operating costs increase relative to the mileage accumulated. In this example, the operating costs include maintenance, loss of driver productivity caused by reduced vehicle reliability, and fuel consumption. The sum of operating and ownership costs represents the “lifecycle cost curve.” The ideal time to replace vehicles is before the rise in operating expenses begins to outweigh the decline in ownership costs.

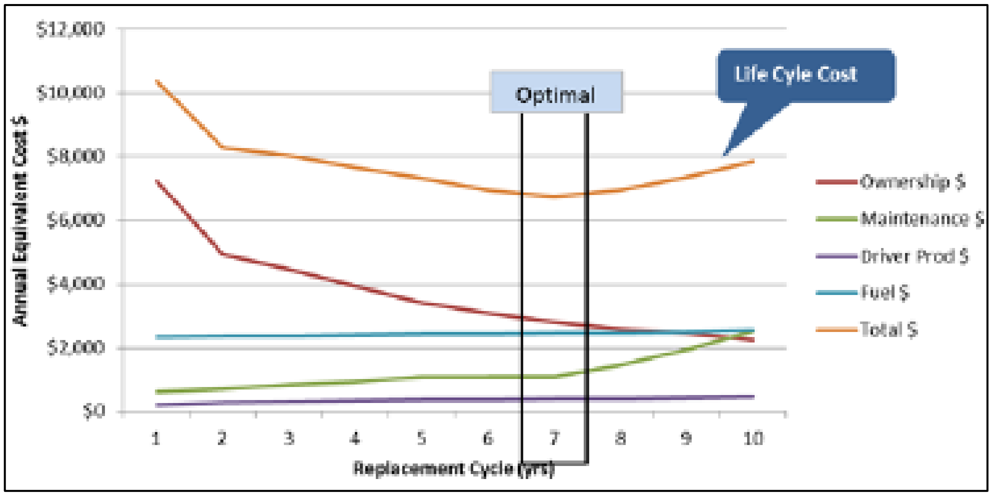

Figure 27. Optimal Lifecycle Assessment

The Lifecycle Cost Curve

The optimal replacement cycle and lifecycle cost curve vary among vehicle types and even individual units due to factors like make/model, model year, equipment design, operating conditions, and operator habits. Recommended replacement cycles offer category-average guidance, but fleet managers should use judgment and principles, considering the weighted condition assessment for individual cases. Lifecycles are determined through discounted cash flow analysis, modeling expected cash flows for vehicle ownership and operation. For the Town of Wasaga Beach, the team completed a discounted cash flow analysis for vehicle classes with sufficient data, calculating net present value (NPV) for outgoing and incoming cash flows, and converting NPV to annual equivalent cost (AEC) for easy comparison of alternative lifecycle costs.

Fleet Age and Reliability

Aging commercial vehicle fleets experience higher operating expenses, primarily due to increased unplanned repairs and breakdowns. This leads to elevated downtime costs, especially when multiple individuals rely on a single vehicle, contributing to higher expenses for owning, maintaining, licensing, insuring, and parking backup vehicles. Despite a robust preventive maintenance program, downtime costs are inevitable and can be substantial. Consistent capital reinvestment in fleet modernization is crucial for organizations relying on a reliable fleet, offering benefits such as better fuel economy, increased uptime, reduced repair risks, enhanced safety, and potentially a smaller fleet size with fewer spare vehicles.

Vehicle Replacement at the Rate of Depreciation

Providing capital to replace units each year with new vehicles is essential for any organization that relies on its fleet to provide its core services to customers. A guideline for fleet replacement is to invest capital at the rate of depreciation. For example, if vehicles are depreciated over ten years, then 10% of the total fleet replacement cost (current NPV) would be required each year to maintain the fleet's average age at the desirable level. However, this guideline is only valid if performance indicators such as uptime and fuel-efficiency are satisfactory. If not, a one-time increase in spending would help bring the fleet's average age and performance up to an acceptable level.

Vehicle Replacement Criteria

Today's vehicles are built better and last longer than ever before. With the right preventive maintenance, operating conditions, and driver behaviours, vehicle service lives can often be extended longer than in the past. The LCA completed for this report optimizes vehicle lifecycle costs based on vehicle age. Vehicles approaching their end-of-lifecycles should be assessed case by case with a thorough ground-up and top-down physical assessment of the vehicle's condition, as this would serve to inform and confirm decisions around extending their lifecycles.

For higher annual mileage vehicles in the fleet, it is recommended that the Town of Wasaga Beach reviews the condition of high mileage vehicles at thresholds of 20,000 km/yr for light-duty vehicles (LDVs) and 25,000 km/yr for medium- and heavy-duty vehicles (MHDVs) for potential early replacement. The recommended vehicle replacement age can be multiplied by these values to determine mileage thresholds. For example, if the recommended lifecycle is ten years for a vehicle type, the recommended replacement mileage is 10 x 20,000 = 200,000 km.

Environmental Considerations

LCA is used to evaluate whether the increased costs of capital for newer, more modern, and fuel-efficient vehicles will be offset by lower fuel, repair, and downtime costs. For low-mileage units, the amount of fuel saved may be minimal, often resulting in lifecycle extension being the better financial option. However, aging a fleet to extract full value from each unit may counteract the fleet's progress toward modernization and reduced GHG emissions. When modelling battery-electric vehicle (EV) replacement, some units do not show return-on-investment (ROI) due to increased cost of capital exacerbated by low utilization for some units. LCA-extended lifecycles combined with vehicle condition assessments are recommended by the team to extend the lifecycles, wherever possible, of current-day internal combustion engine (ICE) fleet vehicles while awaiting EV replacements to become available.

Key Parameters and Assumptions

The key LCA parameters and assumptions used for all selected vehicle classes are listed in the table below.

Table 26. Key LCA parameters and assumptions

Parameter	Value	Description
Net Acquisition Cost	Varies by vehicle class	Based on average vehicle acquisition cost data provided by Town of Wasaga Beach.
Cost of Capital / Lease Rate	5.07%	10-year projected debt financing rate of 5.04% for WACC[179].
Discount Rate for NPV	1.75%	Rate used to discount cash flows.
Tech. Prod Loss Hrs./Touch	3.0	Average loss in driver productivity each time a fleet technician services a vehicle. Work orders are deemed equivalent to "touches".

[179] Source : https://www.bankofcanada.ca/rates/interest-rates/

Tech. Labour Rate $/Hr.	$54.90	Town of Wasaga Beach's hourly labour rate (burdened).
CIF (cost of inflation factor) on Maintenance	2.0 %	Cost increase factor or inflation on parts and mechanic labour. Projected 2024 CPI of 2.3% to be between 1-3% long-term[180].
CIF on Driver Rate	2.0%	Cost increase factor or inflation on driver loaded labour rate.
CIF on Vehicle	2.0%	Cost increase factor or inflation on vehicle replacement prices.
CIF on Fuel	2.0%	An assumption based on market trends.
Annual Vehicle Efficiency Improvement	2.0%	Fuel efficiency improvement factor for new vehicles compared to the vehicles being replaced (estimated by the team).
Average Km/Yr.	Varies by vehicle class	Annual distance travelled under the assumption that the new vehicle will travel the same distance as the old vehicle.
Cash Flow Horizon (yrs.)	Varies by vehicle class	Discounted cash flow study period adjusted based on the vehicle class (up to 20 years) and years of available data.

LCA is based on average costs and utilization rates for each category of vehicles and provides a credible guideline to optimal vehicle replacement cycles. However, LCA does have limitations since its outcomes are based on average cost data for each category of vehicles. Some vehicles in poor or unsafe condition may require replacement before the LCA-calculated age criteria are met.

Conversely, some vehicles that exceed the criteria may still be in good condition and not warrant replacement due to low usage or recent refurbishment. Therefore, the LCA-recommended replacement criteria should be used as a guideline and not an absolute rule. Aligning with the Town's current practices - the physical condition of each unit should then be assessed case-by-case by trained and knowledgeable staff, who are familiar with each unit's usage and maintenance history before replacement decisions are finalized.

Data Challenges

The discipline of completing fleet LCA is dependent on historical cost data. LCA modelling software was designed and intended to be populated with a fleet's actual historical cost data. Without having cost data and performing LCA, vehicle replacement decisions may be based solely on intuition and personal observations – essentially the sentiments of someone who has a high degree of familiarity with the fleet. Often, it has been observed that "guesstimates" made by seasoned fleet managers can have a high degree of accuracy. However, today's business decisions based on "gut" feelings often do not stand up to scrutiny and must be backed up by analytical data.

Next Step After LCA: Vehicle Condition Assessments

As described, vehicles approaching their end of lifecycle should be assessed case by case. A thorough ground-up and top-down physical assessment of each vehicle's condition, in conjunction with routine shop visits for preventive maintenance inspections, would serve to inform decisions around extending vehicle lifecycles. A weighted point system should be used to determine vehicle condition and qualification for replacement.

[180] Source: http://www.cvse.ca/index.htm

For the analysis, Town Fleet staff were asked to rate their units as to physical condition. This table was used to make vehicle deferral selections to balance the go-forward, year-over-year fleet budgets.

b) Results

Lifecycle Assessment Results Summary

A Lifecycle Assessment (LCA) was undertaken to calculate the optimal economic lifecycles for vehicle replacements. LCA was completed for select vehicle categories where sufficient historical data was available from the Town of Wasaga Beach. Peer municipal fleet data from the database was used to fill numerous data gaps. The LCA took into consideration the cost of downtime (as caused by reduced reliability), the year-to-year "rollup" of the cost of capital, inflation, worker cost/hour, salvage and market values, inflation, and average kilometres-driven data. The results are summarized in Table 27.

Table 27. Lifecycle assessment by class/type

Class	Type	Current Replacement Cycle (years)	Lower LCA Extended Lifecycle (years)	Upper LCA Extended Lifecycle (years)	Change (+ or – years)
2	Pickup	7	11	13	+4 to +6
1	SUV	7	10	14	+3 to +7
6-8	Firetruck	13	17	18	+4 to +5
8	Truck (Not including firetrucks)	11	14	15	+3 to +4

The LCA charts were included for each applicable vehicle category below:

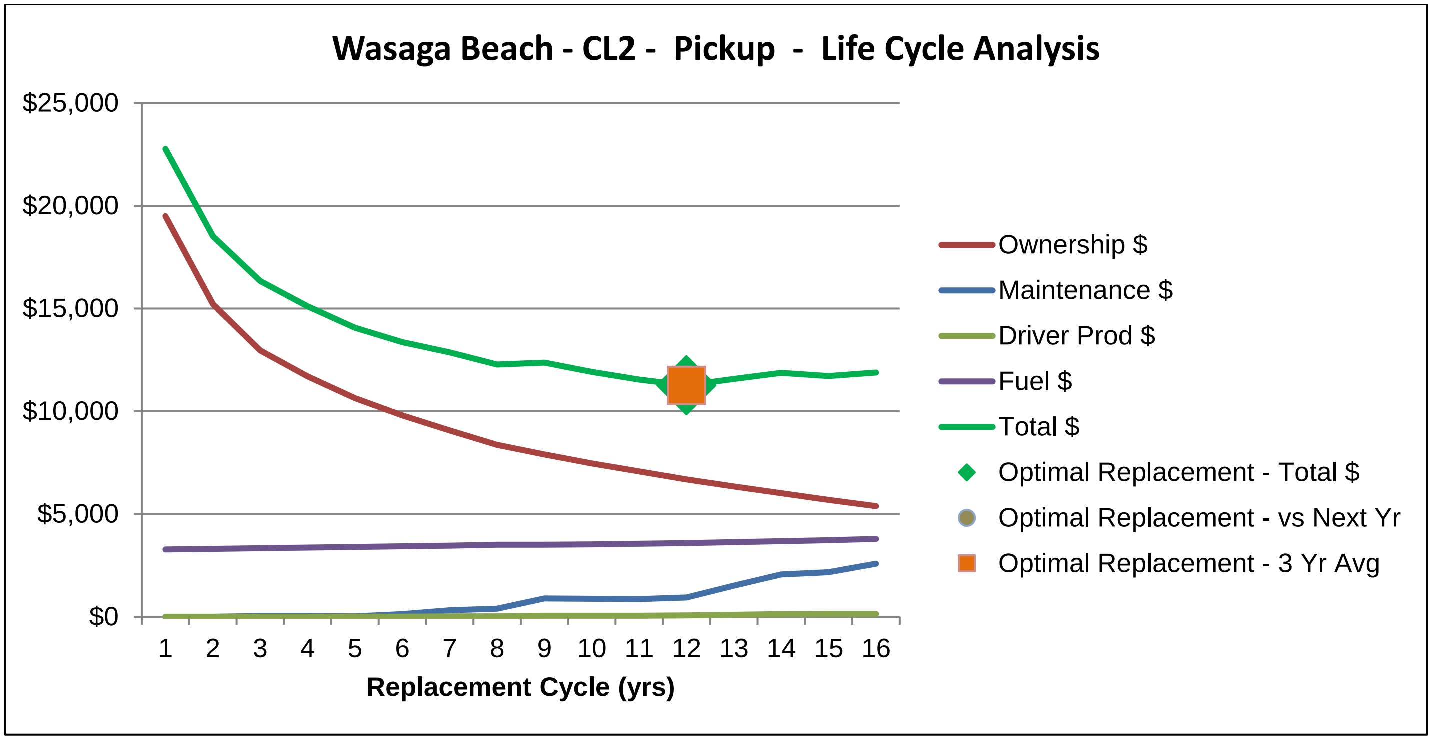

Figure 28. LCA Analysis - Class 2 Pickups

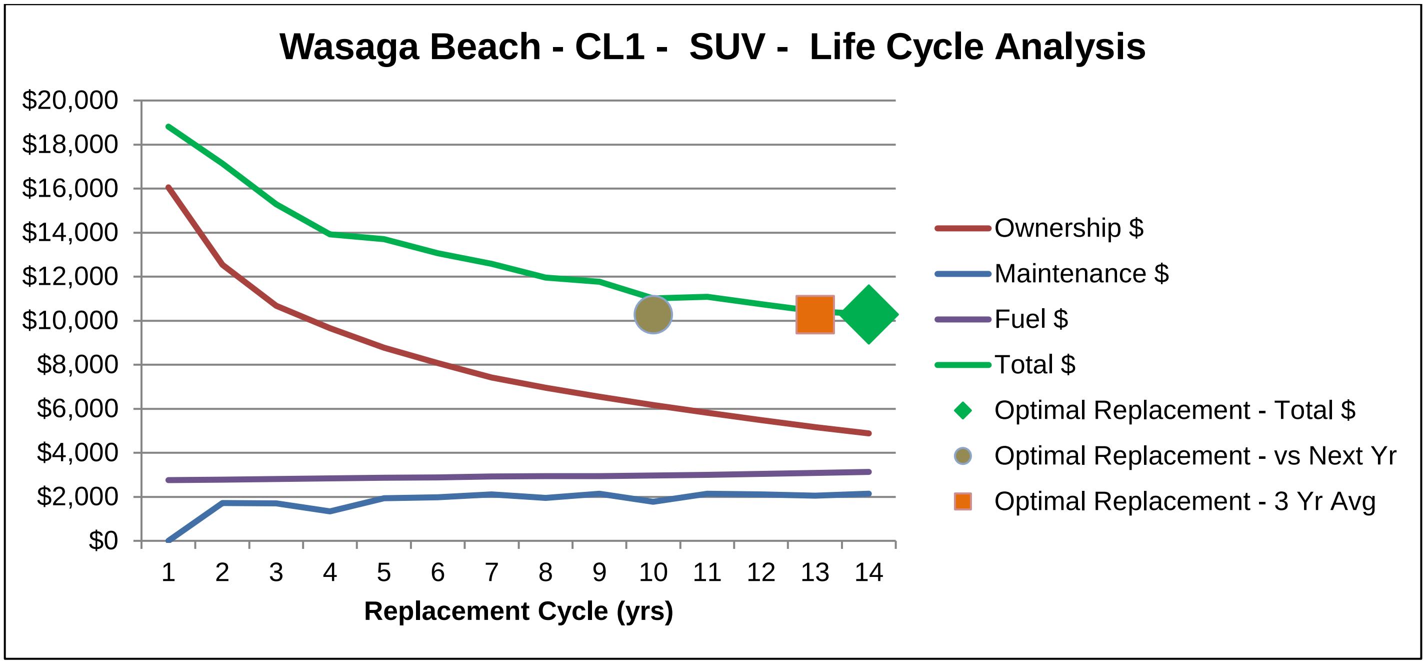

Figure 29. LCA Analysis - Class 1 SUVs

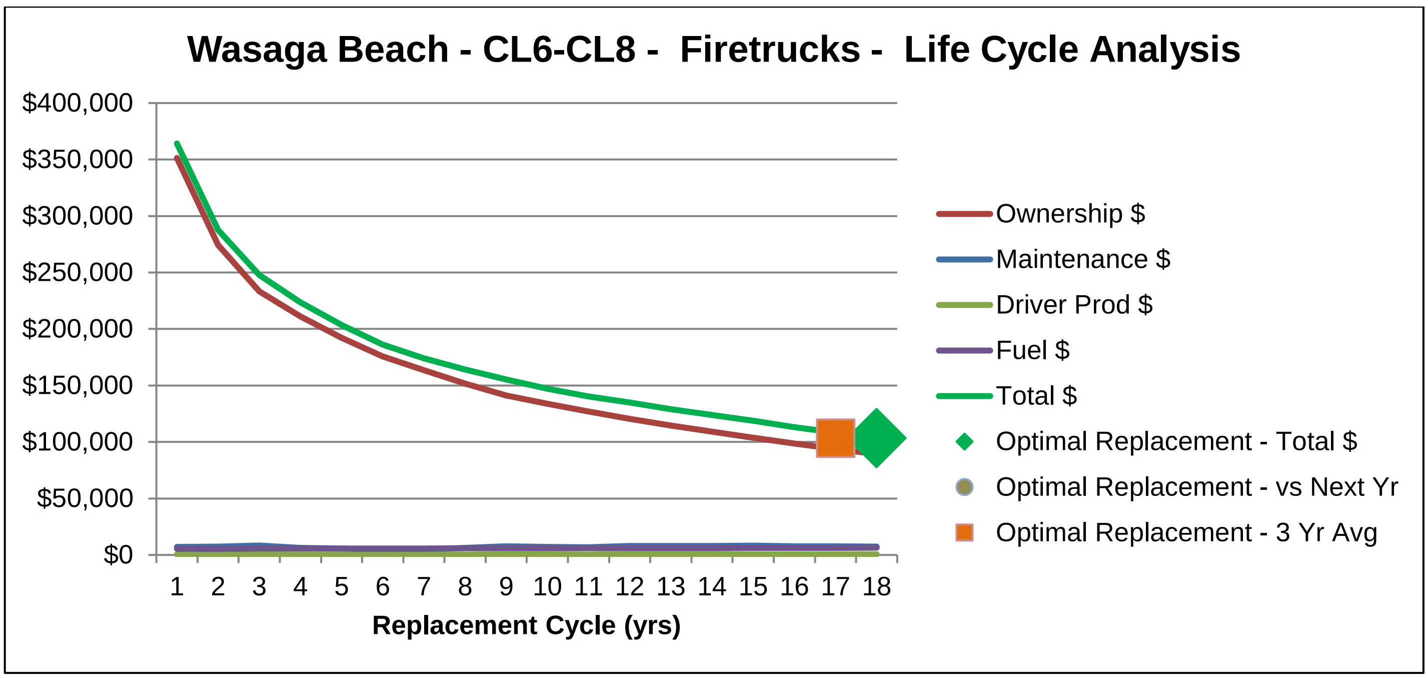

Figure 30. LCA Analysis - Class 6-8 Firetrucks

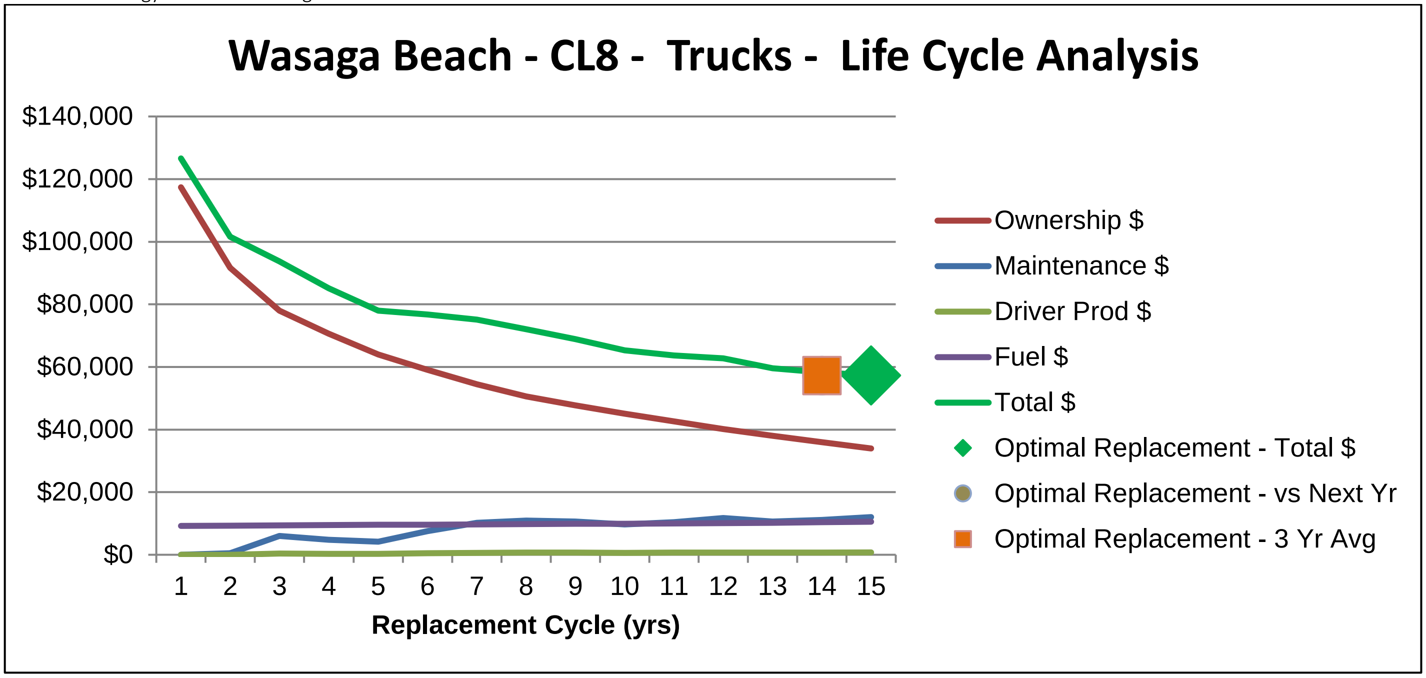

Figure 31. LCA Analysis - Class 8 Trucks

Appendix B: Survey Responses

A management and a driver survey for the Town of Wasaga Beach's fleet users were conducted in February of 2024. The survey aimed to gather comprehensive insights into past fleet operations, understand practices, identify areas for improvement, and collect data for a detailed analysis to enhance operational efficiency and sustainability.

General Questions

A total of 35 responses were collected, with 21 from staff members and 14 from management personnel. Below are the responses:

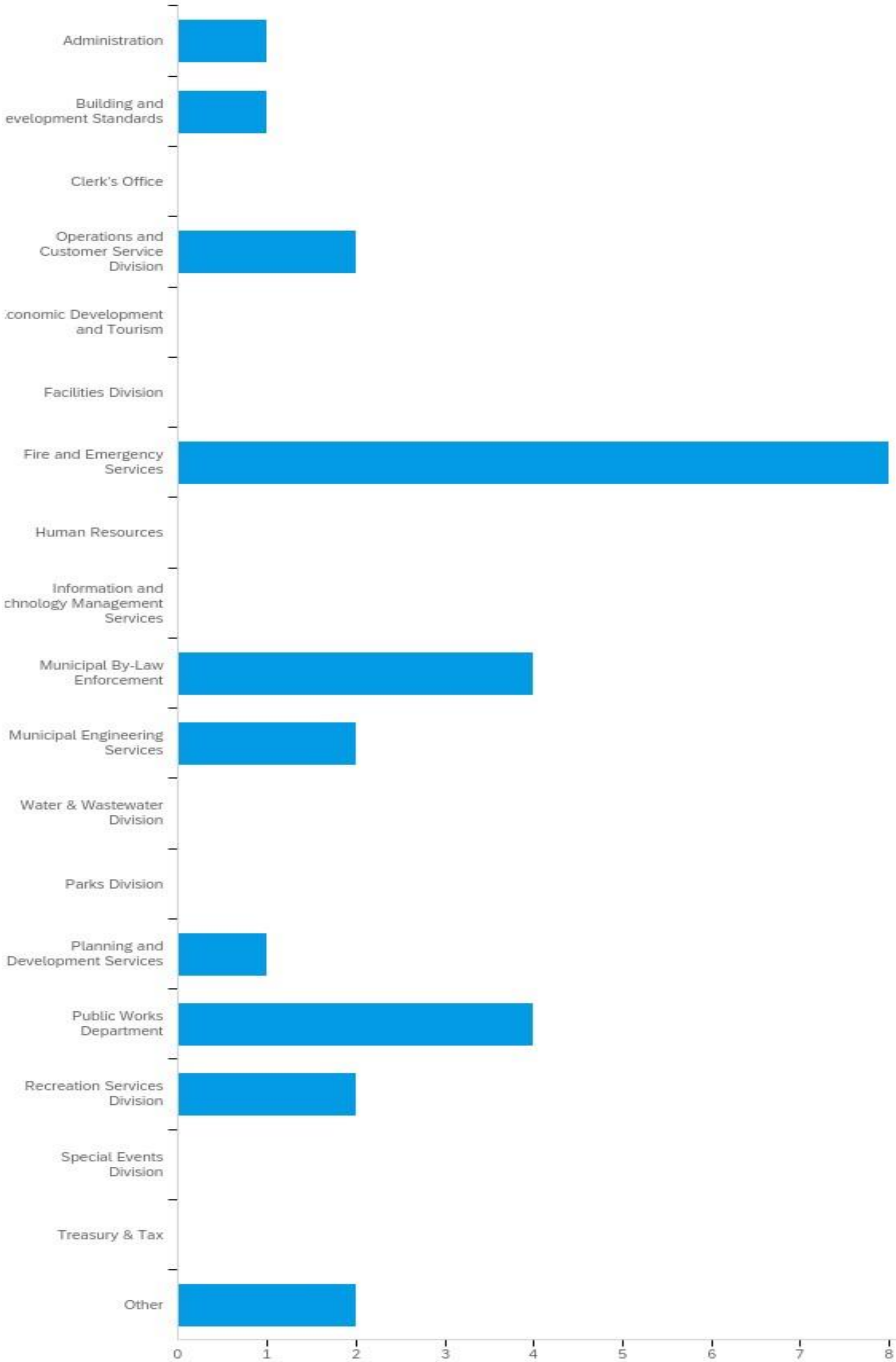

Figure 32: Breakdown of drivers' departments

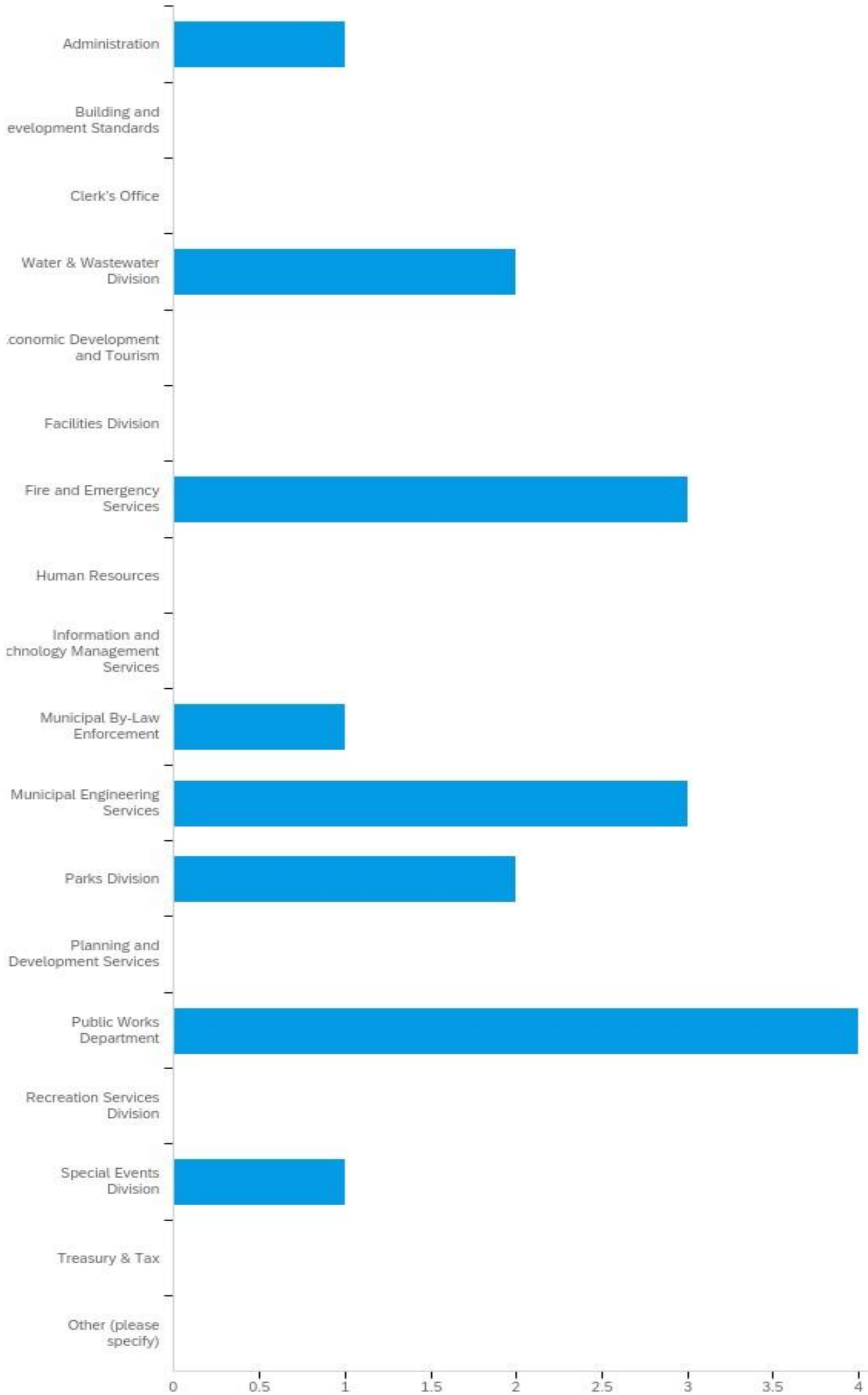

Figure 33: Breakdown of management's departments

The largest group of respondents in the surveys were identified as a part of the Fire and Emergency Services. Given the lack of renewable replacement opportunities for firetrucks, there may be added unfavourable sentiment towards renewable replacement vehicles for those in this department. The next largest group of respondents came from the Public Works Department, followed by the Clerk's Office. Figure 34 and Figure 35 present the types of vehicles used by the fleet operators:

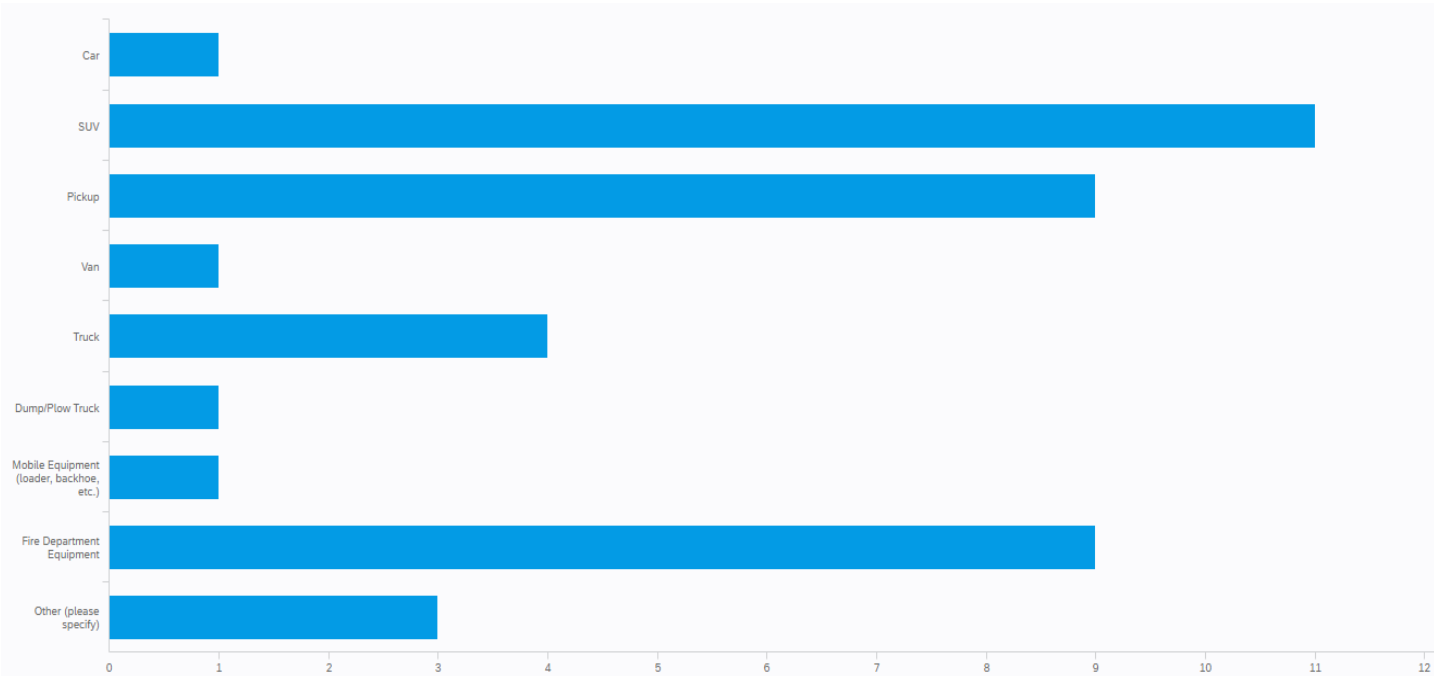

Figure 34. Types of vehicles used by drivers

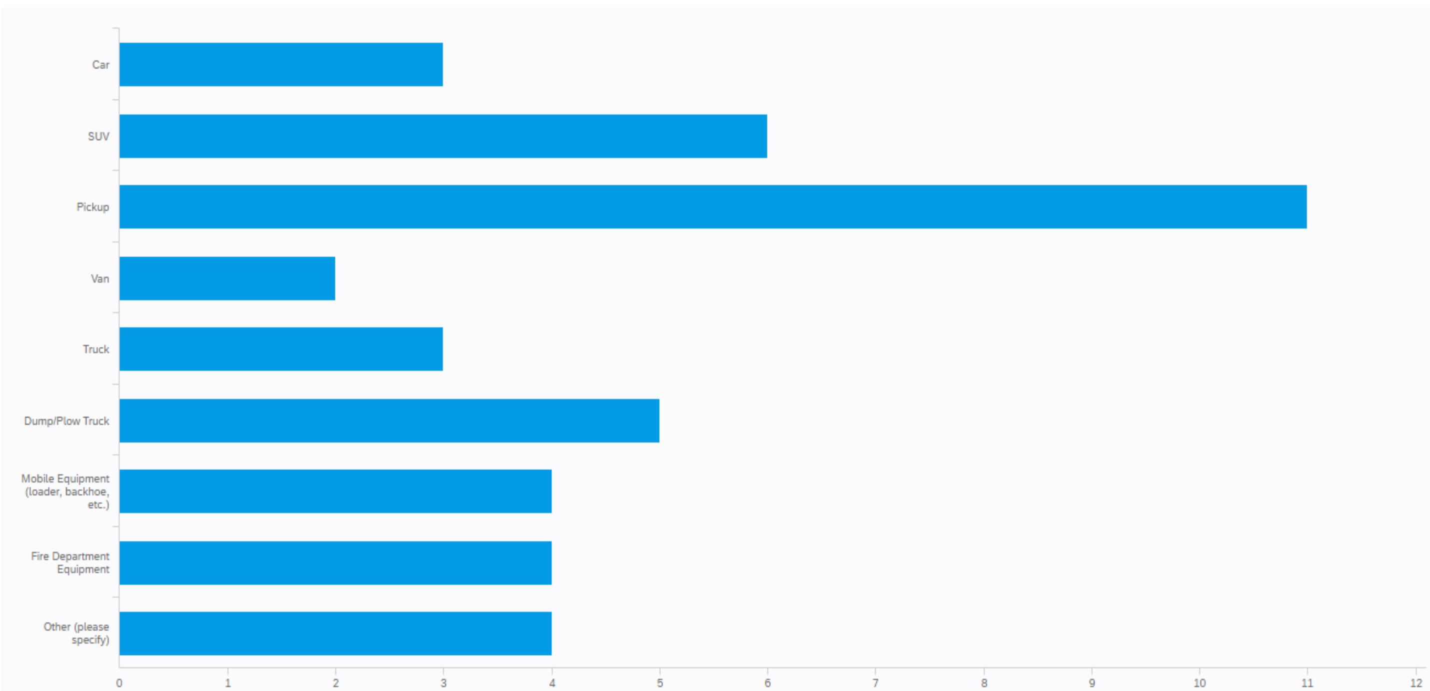

Figure 35. Types of vehicles used by management

Based on survey results, pickups are much more common for management to drive relative to drivers, who are slightly more likely to drive an SUV.

Vehicle and Equipment

Vehicle size and capacity was inquired about in order to determine if the replacement vehicles needed to be larger. The results are shown in Figure 36 and Figure 37.

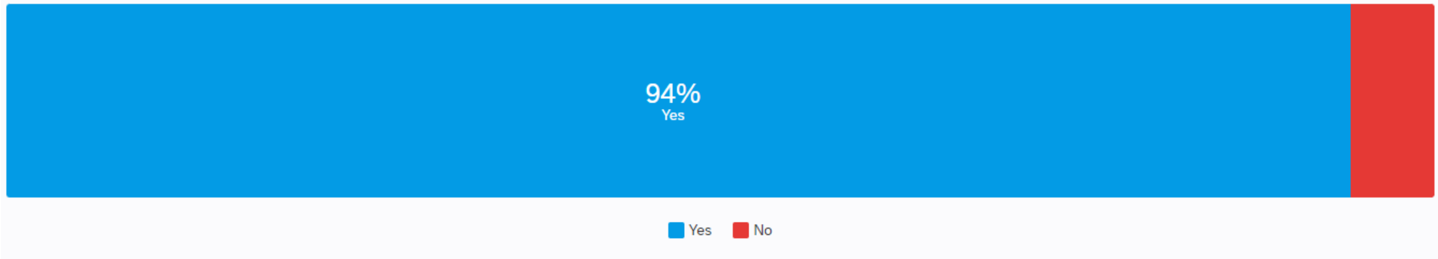

Figure 36. Drivers' opinion on if current vehicles/equipment are a suitable size or capacity for their team's needs

Figure 37. Managements' opinion on if current vehicles/equipment are a suitable size or capacity for their team's needs

Based on survey results, there appears to be no need to adjust the weight class of the replacement vehicles to account for increased capacity.

Regarding vehicle age, 11 driver respondence claimed that the age of the vehicles/equipment are suitable, while 6 said they are not. Responding to the same question, 7 management respondents said yes, while 5 said no. The respondence that responded no were asked why they are not. The following are there responses:

- *“But as a refurbished retired Fire Truck/EMS it is getting old”*
- *“pumper trucks should be replaced sooner”*
- *“Generally yes but we need to look at reducing the life span of the pumpers. we are getting too busy to keep the front line pumpers for 12-15 years”*
- *“We have a couple of old surpluse vehicles that are simply not reliable. They are constantly needing to be boosted or have other issues looked at.”*
- *“Older vehicles that have regular issues such as not starting.”*
- *“We do have a few vehicles that are older, they are not reliable as the vehicles dies while in the field as experience last summer.”*
- *“room for improvement”*
- *“A lot of our Kubota equipment is 15 to 20yrs old”*
- *“maintain the seven year cycle”*
- *“Some vehicles are pushing 10 years old”*

The responses tend to have three main themes. The first, is that the fire department may have old vehicles that need replacement. Pumper #3 is 22 years old, which is older than the current and the Green Fleet Strategy suggested lifecycle, and appears to be a cause for concern.

Similarly, some vehicles, such as Kubota equipment, is older than the intended lifecycle. If the vehicle is also deemed to be in bad condition, then replacement of the vehicle should be considered. The balancing of the CAPEX in the Green Fleet Strategy should assist with this, as it creates a more concrete and feasible plan for replacing all vehicles, instead of normalizing the extension of vehicles' replacement schedules.

Lastly, preventative maintenance may need to be increased, especially for older vehicles. This is especially the case if the issues are 12V battery-related, which appears to be the case, and is not worth replacing a vehicle over. If the issues are actually more expensive than this, then replacing the vehicle should be considered.

Feedback and Suggestions

Finally, the survey concluded by seeking opinions on the implementation of BEVs and perspectives on how the Town can enhance its operations. Here are some examples provided by respondents:

- *"The initial investment will be costly. Perhaps there are incentives & grants that may help to offset a commitment to transition the fleet to a more sustainable & green fleet."*
- *"For municipal law enforcement, we do like they hybrid so we have gas as a back up but its not to say we cant use BEV's going forward and its a great option for departments that can use these!"*
- *"The funding needs to become available for what each department needs to run their operations safely/efficiently."*
- *"I think it's suitable especially for smaller ICE vehicles that don't leave town limits"*
- *"Technology is not proven yet for the fire department large fleet (pumpers, rescues etc.) but should be considered for smaller admin fleet"*
- *"The challenge is we would need staff charging stations. I do not know how many we could fit and do not see enough for all fleet. Would need a hybrid solution."*
- *"A full costing analysis has to be completed before switching the fleet. Test with a few first."*
- *"The technology has not advanced far enough to do the work. Hauling heavy loads, pushing snow, excavating holes, etc. cannot be met with BEV."*
- *"We need to cut down on idling. I think BEVs aren't THE fix but are a step in the right direction"*
- *"I feel hybrid vehicles are best moving forward. We need enough vehicles for each department to have for staff members on a daily basis. Old vehicles that constantly need to be jumped should be switched out for newer models."*
- *"testing BEVs for commuter vehicles would be a start. would give you an idea of how they perform and the costs involved in the long term. i wouldnt bet that BEVs will be the answer on emergency vehicles, plows, loaders or any other crucial vehicle until all the questions are answered."*
- *"Make sure the infrastructure is in place so the transition to EV is easier."*
- *"A larger shop would be a huge benefit to a fleet that continues to grow."*
- *"maybe possible to downsize the fleet remove vehicles that are only being used periodically. pay employees mileage to use their own vehicles where possible"*

- *“fleet services is doing a great job, looking forward to the future change”*

Appendix C: Management Practices Questionnaire Responses

The following section covers the most relevant sections of the Management Practices Questionnaire for developing the Green Fleet Strategy and contain the responses that were provided by the Town. This includes responses regarding asset management, financial decision making, human resources, safety, and environmental-related operations.

Since three individuals assisted with answering the questionnaire (Director of Public Works, the Fleet Manager, and the Manager of Operations for Public Works), there were sometimes multiple answers that did not align with each other. In these scenarios, both responses were provided.

Asset Management

Asset management: “a systematic process of deploying, operating, maintaining, upgrading and disposing of assets cost-effectively”. In this section of our report, the team wishes to learn about the cradle to grave handling of fleet assets.

a) *What method is used to determine a vehicles lifecycle? (describe)*
   - *Wasaga has a tangible capital asset guideline that is approved by council based on industry best practice for determining the lifecycle.*

b) *Who is responsible for determining lifecycles?*
   - *Fleet manager and then approved by council*
   - *Relevant staff, professionals, and industry standards guides are consulted*

c) *How frequently are lifecycles re-assessed? (describe)*
   - *On an as needed basis*
   - *As required*

d) *What criteria/methodology is used to determine when a unit is going to be replaced? For example, is it based on corporate policies for replacement years alone or is it also based on unit condition, accumulated kms/hours, etc.? (describe)*
   - *1. Current life cycles, 2. km/hrs, 3. Unit condition*
   - *Replacement year + condition assessed by fleet manager and mechanic(s)*

e) *What is the process when a department wants to add another vehicle to their department? (describe)*
   - *Business case report to council*
   - *Capital forecasting, budget deliberation, and DC background study*

f) *Are vehicles, ancillary equipment, truck bodies, or equipment ever re-built/refurbished to extend their lifecycles? (if yes, when and what are the determining factors?)*

- *On an as needed basis, not typical*
- *From time to time (i.e., grader refurbish)*

Financial

One of the biggest challenges facing fleet managers in both the private and public sectors is fiscal sustainability – will there be sufficient revenue to offset both operational expenses (OPEX), plus the costs of capital investment in the fleet (CAPEX)?

It can be a delicate and complex balancing act - for example, in the case of a commercial fleet engaged in providing commercial trucking services, the fleet manager must not only focus on reducing OPEX and CAPEX, but also include a profit margin.

One of the fleet manager's tasks is reducing vehicle capital and operating expenses without negatively affecting service levels (uptime). In this section, we sought to begin learning about the vehicle capital fund - how it is refreshed, how vehicle costs are re-covered, etc.

a) *Are vehicles owned, leased, or rented?*
    - *Owned*

b) *Is a capital budget reserve fund in place? How does it work?*
    - *Yes*
    - *Yes – vehicles/equipment are typically funded 50% by the reserve*

c) *Is a vehicle/equipment client chargeback system in place now? (please describe)*
    - *Yes*

    a. *If yes to above, are all vehicles and equipment included in the chargeback system?*
        - *Yes*

    b. *If yes to above, is the total cost of fleet services, including capital and fleet operating budgets, recovered -via the chargeback system?*
        - *No*

d) *Are at-fault accidents or negligent damages charged back to the client dept/user group that caused the damage?*
    - *If it's an insurance claim = no. if repairs are done in house = yes.*
    - *Not typically (?) / Insurance claim*

e) *Are fuel charges transferred to clients / user groups?*

- *Yes*

f) *Do budget reports include line items for labour, parts, fuel, maintenance, licenses, capital replacement etc.? Or do you get this via your Financial Management Information Systems (FMIS)?*
   - *Monthly reports from finance, one for capital and one for operating*
   - *Yes*

g) *Are annual operating budgets based on historical actual spend in previous OPEX budgets?*
   - *Yes*

h) *Does someone have responsibility for reviewing historical OPEX for superfluous expenses, under/overspending? How often are they reviewed?*
   - *Budget analyst, as requested*

i) *Is LCA (Lifecycle Cost Analysis) used to prepare capital budget?*
   - *Not sure*

j) *Is vehicle condition taken into consideration when due for replacement by age/mileage criteria?*
   - *Yes*

k) *Are long-term capital budgets prepared (5 years minimum)?*
   - *Yes, 10 years*

Human Resources

For a fleet, the topic of human resources pertains to the fleet department's team as well as the drivers of the fleet's vehicles. For many small to mid-size fleets, managing the fleet team may be just one aspect of a diverse portfolio of roles for a Supervisor, Manager or Director.

a) *What are the Fleet management team's roles and reporting hierarchy within the fleet department (describe the positions, the numbers of each, and who they are)?*
   - *Director pw, Fleet manager, mechanics (2)*

b) *Are fleet managements team members in organizations such as NAFA, APWA, CAMFM etc.?*
   - *Yes*

c) *What roles are unionized and who are they and what do they do? Describe each position's responsibilities.*
    - *Mechanics (2)*

d) *Who do the unionized staff report to?*
    - *Fleet manager*

e) *Is the fleet responsible for driver training?*
    - *Yes, in part*

f) *Please describe the driver training practices and how it works, who manages it, who is responsible etc.?*
    - *Driver training is currently provided through public works dept.*
    - *Fleet manager and ops manager manage it, while it is also included in RFP's as requirement*
    - *Drive Wise comes every other year to the Town rodeo and all drivers get seat time*

g) *Please describe the driver management program*
    - *Drive Wise has different scenarios, focusing on winter snow plowing, as that is the most conflicting time*

h) *Is eco-driver training provided?*
    - *Not to my knowledge*
    - *No*

i) *How often are driver abstracts reviewed?*
    - *Only if there are suspected issues*
    - *As required*

j) *Who requests driver abstracts and reviews them?*
    - *Operation, fleet*
    - *Department head / HR*

k) *Are driver abstracts reviewed pre-hire?*
    - *Yes, submitted as part of acceptance offer*

l) *Is remedial training provided for drivers with poor abstract records or with multiple at-fault accidents?*
   - *Yes, if needed*

m) *Is there progressive discipline policy for such drivers? (describe)*
   - *Yes, Union Collective Agreement*

n) *Are there regularly scheduled driver meetings?*
   - *Yes*
   - *As required, if issues develop*

o) *Is there a driver handbook?*
   - *Yes*
   - *No ?*

p) *Is there a fleet advisory committee in place?*
   - *No*
   - *Sometimes – Vehicle / Equipment Tender Advisory Committee*

Safety

Motor vehicle crashes are a leading cause of death and injury for all ages. Crashes – both on and off the job have far-reaching financial and psychological effects on employees, their co-workers and families, and their employers.

The use of a cell phone while driving, either handheld or hands-free, makes it four times more likely that a driver will crash, as per the U.S. National Safety Council. In Canada, regulations governing commercial vehicles, drivers, and motor carriers are based on the Canadian National Safety Code (NSC) standards. The NSC is a code of minimum performance standards, applying to all persons responsible for the safe operation of commercial vehicles.

The following information is not only important for ensuring the safety of drivers, but also for determining what additional training may be required to implement the Green Fleet Strategy safely.

a) *Do you have safe driver and training programs in place?*
   - *Once every other year*

b) *How frequently are drivers receiving professional driver improvement (PDIC) driver refresher training?*
   - *Yes and No*

c) *Is training in-sourced? (i.e. a staff driver trainer?)*
   - *Experienced operators as well as Third party Certified Companies*

d) *Who gives instruction on equipment? (loaders, backhoes etc.)*
   - *Yes*

e) *Is snowplow training provided? (such as Ontario Good Roads Assoc.?)*
   - *Yes*

f) *Ever gone through a ministry of transportation facility audit preparedness review? (pre-audit)*
   - *Yes*

g) *Is your Commercial Vehicle Operator's Registration (CVOR) / Safety rating satisfactory (or better)?*
   - *Yes*

h) *Do you have annual (at minimum) CVOR review?*
   - *Yes*

i) *Who is responsible for getting CVOR rating reports?*
   - *Clerk*

j) *How are pre-trip inspections handled?*
   - *Logged in book at the start of each trip*

k) *Are they paper-based?*
   - *Yes*

l) *Who is responsible and/or reviews them?*
   - *Mechanic, Fleet, Operations*

m) *What is the workflow/process for managing pre-trip inspections?*
   - *Driver completes log, defines issues, reports directly to Mechanic and Foreman*

n) *How long are paper records kept?*
   - *Seven years*

Environmental

Environmental questions were asked in order to determine the current-state of Wasaga Beach's green fleet activities.

a) *Is there a corporate carbon-reduction target in place?*
    - *No*

b) *Is your environmental management system up to ISO14001 registration?*
    - *Not sure*

c) *Hybrids in place?*
    - *Yes*

d) *Are there EVs in place?*
    - *Yes*

e) *Alternate fuels in use?*
    - *No*

f) *Renewable fuels in use?*
    - *No*

g) *Tire recapping (tire retreading)?*
    - *Yes*

h) *Filter recycling?*
    - *Yes*

i) *Oil recycling?*
    - *Yes*

j) *Vehicle wash water reclaimed or recycled?*
    - *No*

k) *Eco-friendly products used in maintenance activities?*

- *Not really*

l) LED lighting in facilities?
- *Yes, many*

m) Engine idling reduction policy? Is it enforced?
- *There is a policy*

n) Route mapping/trip optimization review?
- *Not sure*

o) Driver eco-training provided?
- *Not sure*

Appendix D – Purchase, Lease & Rent Analysis

This analysis serves as an illustrative example of the factors that should be taken into consideration when conducting a Purchase, Lease & Rent Analysis. It is based on a previous project and aims to provide a practical demonstration of the key considerations involved in such an analysis.

Business Assumptions for the Purchase, Lease & Rent Analysis

To complete the analysis for each option, several business assumptions were required. The analysis and comparisons were based on the three cases around one vehicle-type (class 1 sedan). This vehicle-type was used since it is a common vehicle-type with comparable expenses to other light-duty vehicles. Furthermore, to obtain accurate data for rental rates and contractual conditions, information from a recent municipal client was utilized. This particular municipality had recently received competitive quotes from various rental companies for a similar sedan (2021).

Here are the following business assumptions for the study:

- *Vehicle type: Class 1 Sedan*
- *Acquisition cost: $27,130*
- *Annual days-of-use: 261*[181]
- *Cash flow horizon: 12 years*
- *Lease term (Case 2a): six (6) years – two back-to-back 6-year leases*
- *Lease term (Case 2b): six (6) years - w/ cash purchase for residual value after year six*
- *Lease interest rate: 7% (includes estimated rates and profit adder)*
- *Rental rate: Class 1 Sedan: $450 per month*
- *Projected resale value annual decrease: 2%*
- *NPV discount rate: 1.75%*
- *Inflation rate: 2.45%*
- *Average fuel consumption: 9.5 liters/100km*[182]
- *Annual kilometers travelled: 29,870*
- *Planned replacement lifecycle (months): 144*
- *Cost of capital: 2.45%*
- *Cash flow horizon (months): 144*
- *Spare vehicle cost/km*[183]*: $0.15 ($0.00 for the rental option)*
- *Oil changes and minor PM inspection intervals: 7,000 km*
- *Maintenance, repair costs: owner/lease expense (for purchase and lease cases only)*
- *Miscellaneous lease fees and surcharges: $75 per month*
- *License costs: owner/lease expense (for purchase and lease cases only)*

Operating Costs – Buy and Lease Case

Based on the business assumptions presented, the annual operating in each year of the 12-year horizon were estimated. Please see Table 28 (below). Note: Operating expenses varied for each case. The baseline year costs were adjusted to account for inflation in each year of the 12-year horizon.

[181] Analysis based on five days per week, nine statutory holidays per year
[182] Based on a class 1 sedan's previous fleet analytics review analysis
[183] Acquisition cost of a class 1 sedan – used for the purchase case DCF analysis

Table 28. Annual Operating Expenses

Operating Expenses (buy or lease)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Maintenance and repair ($/yr.)	$700	$725	$917	$1,088	$1,130	$1,067	$1,200	$1,163	$1,233	$1,185	$2,459	$2,329
Fuel/electric ($/liter or kWh)	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178
Licence ($/yr.)	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120	$120
Total operating costs[184]	$3,998	$4,023	$4,215	$4,386	$4,428	$4,365	$4,498	$4,461	$4,531	$4,483	$5,757	$5,627

Case 1: Purchase

With the assumptions described above, the lifecycle total cost of ownership (TCO) for Case 1 was calculated. In this case, the analysis was data-modelled for the sedan; it depicts the impacts of purchasing and maintaining the sedan in-house through its entire lifecycle. Please see Table 29: Case 1 - Purchase – Sedan (below). The estimated average annual TCO for a sedan is $7,188. The TCO over a 12-year lifecycle was estimated to be $86,257 per unit.

Table 29. Case 1 - Purchase – Sedan

Operating Expenses (Case 1 - Buy)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Cost of capital (opportunity cost)	$649	$636	$618	$603	$589	$575	$561	$548	$535	$522	$509	$497
Depreciation	$4,070	$4,070	$4,070	$4,070	$4,070	$4,070	$0	$0	$0	$0	$0	$0
Operating Cost[185]	$3,998	$4,096	$4,196	$4,299	$4,405	$4,513	$4,623	$4,736	$4,852	$4,971	$5,093	$5,218
Cash flow	$4,647	$4,729	$4,815	$4,903	$4,994	$5,087	$5,184	$5,284	$5,387	$5,493	$5,602	$5,715
Total cost of ownership	$8,716	$8,799	$8,884	$8,972	$9,063	$9,157	$5,184	$5,284	$5,387	$5,493	$5,602	$5,715

Case 2a: Lease

Then, an analysis was conducted for two different leasing cases. In the first scenario, Case 2a, the sedan would be leased for six years. At the end of the lease, the vehicle would be replaced with another similar unit which would also be leased for six years, to achieve a 12-year lifecycle comparison (i.e., compared to the other acquisition options). The costs of two back-to-back six-year sedan leases are shown in Table 30: Case 2a – Six-Year Lease (x2) (below). For the lease Case 2a of a class 1 Sedan, the average annual cost is $9,862, and the lifecycle total cost of ownership (TCO) is $118,350.

Table 30. Case 2a – Six-Year Lease (x2)

Operating Expenses (Case 2a – 6-Year Lease (x2))	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Lease payments ($/month – includes interest rate & profit)	$5,204	$5,204	$5,204	$5,204	$5,204	$5,204	$5,204	$5,204	$5,204	$5,204	$5,204	$5,204

[184] Inflation is not considered for the total operating costs in this table
[185] Inflation starts in Year 2

Operating cost (fuel, maintenance, licence)	$3,998	$4,096	$4,196	$4,299	$4,405	$4,513	$4,623	$4,736	$4,852	$971	$5,093	$5,218
Misc. fees and surcharges ($/month, estimated)	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75
Cash flow	$9,277	$9,375	$9,476	$9,578	$9,684	$9,792	$9,902	$10,015	$10,131	$10,250	$10,372	$10,497
Total cost of ownership	$9,277	$9,375	$9,476	$9,578	$9,684	$9,792	$9,902	$10,015	$10,131	$10,250	$10,372	$10,497

Case 2b: Lease

In the second lease case, Case 2b, the cost of leasing the sedan for six years, then purchasing the vehicle for its residual value at the end of the lease, was analyzed. The vehicle would remain in service until the end of its 12-year lifecycle. The costs of a six-year lease for a sedan with a buyout at the end of the lease, then buying and operating the vehicle for another six years are shown in Table 31: Case 2b – Six-Year Lease with Buyout (below). For lease Case 2b of a class 1 Sedan, the average annual cost is $7,474, and the lifecycle total cost of ownership (TCO) is $ 89,690.

Table 31. Case 2b – Six-Year Lease with Buyout

Operating Expenses (Case 2b – 6-Year without buyout)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Lease payments ($/month – includes interest rate & profit)	$5,204	$5,204	$5,204	$5,204	$5,204	$5,204						
Buy & dep. Years 7-12							$452	$452	$452	$452	$452	$452
Cost of capital years 7-12							$0	($11)	($21)	($30)	($39)	($48)
Operating cost (fuel, maintenance, licence)	$3,998	$4,096	$4,196	$4,299	$4,405	$4,513	$4,623	$4,736	$4,852	$4,971	$5,093	$5,218
Misc. fees and surcharges ($/month, estimated or per RFP)	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75
Lease: Cash flow	$9,277	$9,375	$9,476	$9,578	$9,684	$9,792	$5,150	$5,264	$5,380	$5,498	$5,620	$5,745
Total cost of ownership	$9,277	$9,375	$9,476	$9,578	$9,684	$9,792	$5,150	$5,253	$5,359	$5,468	$5,581	$5,697

Both leasing cases (2a and 2b) were higher-cost cases for vehicle acquisition relative to the purchase case. However, for both lease cases, several critical assumptions used in the analysis were unknown, and they could potentially shape the outcome of the study. Specifically, these were:

- ***Purchase price:*** *Since vehicle(s) would be purchased by the leaser and leasing companies may be able to buy vehicle for a lower price, this one assumption could be a game-changer in favour of leasing.*
- ***Interest rate:*** *The interest rate charged to the Town of Wasaga Beach by a potential lessor is unknown. Typically, this rate is the product of the lessor's costs of the lessee's creditworthiness, both of which are unknown. An estimated market-based rate as a workaround was used, but a firm cost must be determined through competitive bidding.*
- ***Profit:*** *It is safe to assume all leasing companies wish to make a profit and that a profit adder would be charged to the Town of Wasaga Beach on top of interest charges. However, the percentage of the potential lessor's exact profit margin is unknown. Therefore, a "safe" (low) assumption as a workaround was used.*

- ***Service charges:*** *It is safe to assume that all leasing companies include administrative and other service fees in their lease charges. Exactly which fees and what the costs might be are unknown. A safe (low) rate was used as a business assumption as a workaround.*
- ***Reconditioning:*** *For Case 2a, closed-end leasing, lessors typically charge the lessee to restore the vehicle to a predetermined state at the end of the term. The degree or level of reconditioning should be negotiated with potential lease vendors at the outset – for analysis, this was an unknown.*
- ***Lease term:*** *A six-year term was used; shorter periods are available, impacting the monthly lease charges.*
- ***Residual value:*** *The residual value at the end of an open-end lease can be negotiated with lessors. For the analysis, the vehicle value was reduced by 2% annually.*

Important note: The many unknown business assumptions (listed above) could alter the outcomes of the leasing cost analysis. It is possible that the cumulative impact of preferential interest rates combined with a reduced cost of vehicle acquisition (and other factors), the lease example could become more favourable. Therefore, if the Town of Wasaga Beach is ever considering leasing as an alternative to purchasing or renting, the municipality should first issue an RFP or RFQ to determine these costs with absolute clarity. Then, with certainty around these key assumptions, lease versus buy DCF analysis should then be recalculated.

Case 3: Rent

For this example, the analysis was based on municipal peer data, and the following assumptions for a rental contract were made:

- *Rental units are on a full-service plan.*
- *All scheduled maintenance is included in the cost and performed offsite.*
- *The rental agency is responsible for replacing a vehicle if downtime exceeds 24 hours for any reason.*
- *Vehicles are no older than three years.*
- *Town of Wasaga Beach is responsible for paying monthly charges only.*
- *Maintenance and licensing and normal wear and tear costs are included.*
- *The only extra is for damages above normal wear and tear.*
- *Rentals are based on estimated mileage; no over-mileage fees are applicable.*

The costs of Case 3: Renting were calculated, and the results are shown in Table 32 (below). For the rent case of a class 1 Sedan, the average annual cost is $8,653, and the lifecycle total cost of ownership (TCO) is $103,838.

Table 32. Case 3 - Rent

Operating Expenses (Case 3 – Rent)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12
Rent payments ($/month – includes maintenance)	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400	$5,400
Operating cost (fuel only)	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178	$3,178
Misc. fees and surcharges ($/month, estimated)	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75	$75
Cash flow	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653
Total cost of ownership	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653	$8,653

Summary of DCF Analysis

After completing the Discounted Cash Flow (DCF) analysis for purchasing, leasing, and renting cases, modelling results showed that Case 1: Purchase, would provide the lowest total cost of ownership (TCO) over the 12-year lifecycle. Table 33 summarizes the analyses. Based on the modelling, the lowest cost case is when the vehicle is purchased, followed by the 6-year lease with buyback; the rental case followed. Finally, 12 years of leasing resulted in the highest total cost of ownership.

Table 33. Summary of Purchase, Lease & Rent Analysis

Purchase – Lifecycle TCO	Lease w/ buy Y7 – Lifecycle TCO	Rent – Lifecycle TCO	Lease 6-years x 2 – Lifecycle TCO
$86,257	$89,690	$103,838	$118,350

Purchase versus Rent – Other Considerations

High-Mileage Applications: As per the cost calculations for the example of a class 1 Sedan, the rental case would cost $1,465 per year more than purchasing. However, in some high mileage applications, renting can bring more cost certainty and control since the rental agency is obliged to provide new, fresh vehicles. For example, costly mechanical repairs are almost a certainty in the late years of a 12-year life for vehicles with higher-than-average annual kilometers travelled. To counteract this situation, either the vehicle's lifecycle must be reduced, or the prospects of high repair costs will be almost certain; both will increase the TCO for the purchase case. Therefore, renting may be a cost-effective option in some high mileage applications.

Reduced Administrative Effort: Viewing the vehicle procurement options holistically, renting can mean a reduction in administrative effort for a municipality – it is possible that some responsibilities managed internally may be transferred to the rental (or leasing) agency. The cost of administrative effort may be high. For example, tasks such as preparing vehicle specifications and preparing, issuing, and awarding RFQs for vehicle purchases every year, managing, scheduling and supervising vehicle maintenance, and maintaining vehicle service histories are routines that incur administrative effort and, hence, cost. The exact value is likely significant.

Although out of scope for this project, the cost impact of reduced administrative effort could be determined by undertaking an activity-based costing (ABC) exercise. Based on this premise, it is possible that a rental agreement could have cost parity with the vehicle purchasing case and provide cost savings in high annual mileage applications.

Appendix E: Available Grants and Incentives

Grants are often essential for incentivizing new technologies and assist in the profitability of the suppliers as they scale. The Government of Canada, through NRCan, is investing $130 million from 2019-2024 in the Zero Emission Vehicle Infrastructure Program (ZEVIP) to expand the charging network. The program supports various projects, including public-use parking area infrastructure, on-street and workplace charging, light-duty and medium/heavy-duty vehicle fleets, and public transit charging. NRCan's contribution is capped at 50% of total project costs, up to a maximum of $5 million per project[186]. There are other opportunities that the Town can take advantage of that applies to numerous clean technologies that the Town Wasaga Beach may consider purchasing, as seen in Table 34.

Table 34. Federal and provincial grants and incentives available for the Town of Wasaga Beach

Provider	Program Name	Description	Funding	Vehicle-Type
Natural Resources Canada	**Green Freight Program (Stream 1 – Assess and Retrofit)[187]**	Funding for aerodynamics retrofits, anti-idling retrofits, auxiliary power units retrofits, tire retrofits, and others	Up to $250 Thousand ($200 Million)	• *All vehicles*
	Zero-Emission Vehicle Infrastructure Program (ZEVIP) – Owner-Operator Stream[188]	Development of EV chargers and hydrogen refueling stations	50% cost share up to $10 Million ($680 Million)	• *BEV* • *FCEV* • *PHEV*
Infrastructure Canada	**Zero Emission Transit Fund[189]**	Funding for communities to invest in zero emission transit and school transportation	50% cost share ($2.75 Billion)	• *BEV* • *FCEV*
Transport Canada	**Incentives for Medium- and Heavy-Duty Zero-Emission Vehicles Program (iMHZEV)[190]**	Purchase incentive for eligible medium- and heavy-duty vehicles	$10 - $200 Thousand ($548 Million)	• *BEV* • *FCEV* • *PHEV*
	Incentives for Zero-Emission Vehicles (iZEV)[191]	Purchase incentive for eligible light-duty vehicles	$5,000 (less than $200 Million)	• *BEV* • *FCEV* • *PHEV*

[186] Source: https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/zero-emission-vehicle-infrastructure-program/21876
[187] Source: https://natural-resources.canada.ca/energy-efficiency/transportation-alternative-fuels/greening-freight-programs/green-freight-program/green-freight-program-applicants-guide-stream-1/24808
[188] Source: https://natural-resources.canada.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876
[189] Source: https://www.infrastructure.gc.ca/zero-emissions-trans-zero-emissions/index-eng.html#1
[190] Source: https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/medium-heavy-duty-zero-emission-vehicles
[191] Source: https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/incentives-zero-emission-vehicles-izev

Appendix F: Vehicle Weight Classification

The following table outlines the various classifications, weight ranges, vehicle classes, the number of vehicles in the Town's fleet and corresponding vehicle types. The classifications, weight ranges, vehicle classes, and corresponding vehicle types. This classification is essential for understanding the categorization of vehicles based on their weight and typical use. These classifications are defined by the Federal Highway Administration (FHWA) in the United States.

Table 35: Weight classifications, weight ranges, vehicle class, the number of vehicles in the Town's fleet, and corresponding vehicle types

Weight classification	Weight range	Vehicle classes	Number of vehicles in the Town's fleet	Fleet vehicle types
Light-duty	0 – 10,000 lbs (0 – 4,536 kg)	Class 1 - 2	65	• *SUVs* • *Pickups* • *Small cargo vans*
Medium-duty	10,001 – 26,000 lbs (4,536 – 11,793 kg)	Class 3 - 6	17	• *Mini-buses* • *Large pickups* • *Some single-axle trucks*
Heavy-duty	Over 26,001 lbs (Over 11,793 kg)	Class 7 - 8	25	• *Some single-axle trucks* • *Dual-axle trucks* • *Large buses* • *Large construction vehicles*

Appendix G: Evolute Power Building Electrical Reports

Evolute Power visited the Operations Yard, Rec Plex, Sports Park, Town Hall, and Fire Hall 1 to determine the current available capacity and determine the number of chargers that can be installed before a service upgrade is required. Evolute Power also provided estimates for all of the installation costs required in 2024, according to the replacement schedule determined within the Green Fleet Strategy.

Findings for each Key Charging Location:

<u>Operations Yard</u> - (150 Westbury Rd, Wasaga Beach, ON L9Z 0C8)

- Requirement for 2024 - 5 x Level 2 chargers (Core+ 7.2 kW FLO Charger)
- Based on our findings there is currently available capacity for 22 x 7.2 kW CoRe + Level 2 EV charging stations @ 40A / 32 Amp output
- If you decided to install higher amperage FLO chargers at 19.2 kW CoReMAX you will be able to install 6 x 19.2 kW Level 2 chargers
- Just an FYI for future expansion (Level 3's in 2026):
  - With regards to the 3 x Level 3 chargers in 2026, you will require a service upgrade to accommodate the chargers as 50 kW or 100 kW chargers will require a lot more power.
  - In order to accommodate the Level 3 chargers in 2026 you will need 1600A for 50kW chargers, 2000A for 100kW chargers @ 208 which will require a service upgrade.

<u>Rec Plex</u> - (1724 Mosley St, Wasaga Beach, ON L9Z 1Z8)

- Requirement for 2024 - 1 x Level 2 charger (Core+ 7.2 kW FLO Charger)
- Based on our findings there is currently available capacity for 74 Level 2 EV charging stations @ 40A / 32 Amp output
- Rex Plex has a lot of available capacity, if you wanted to add level 3 chargers to the park you could do so without a service upgrade to save costs, there is 276 kVa available

<u>Sports Park</u> - (1888 Klondike Park Rd, Wasaga Beach, ON L9Z 2W8)

- Requirement for 2024 - 0 x chargers for 2024 (Core+ 7.2 kW FLO Charger)
- Based on our findings there is currently available capacity for 21 Level 2 EV charging stations @ 40A / 32 Amp output

<u>Town Hall</u> - (30 Lewis St, Wasaga Beach, ON L9Z 1Z8)

- Requirement for 2024 - 1 x Level 2 charger (Core+ 7.2 kW FLO Charger)
- Based on our findings there is currently available capacity for 10 Level 2 EV charging stations @ 40A / 32 Amp output
- Just waiting on trenching estimates so that a final estimate can be provided.

<u>Fire Hall 1</u> - (966 River Rd W, Wasaga Beach, ON L9Z 1Z8)

- Requirements for 2024 - 0 x Level 2 charger (CoRe+ 7.2 kW FLO charger)
- Based on our findings there is available capacity for 15 Level 2 EV charging stations @ 40A / 32 Amp output.

Evolute Estimates for 2024 Required Installations:

Below is a breakdown of all the costs associated with installing FLO Core+ MAX Level 2 19.2 kW (output 16.64 kW) chargers at the following 3 locations below in The Town of Wasaga.
Each location has been broken down with FLO hardware costs, Trenching estimate costs and Main electrical room costs.

Operations Yard - Requirement 5 x Level 2 (19.2 kW) electric vehicle chargers

FLO Level 2 19.2 kW chargers - hardware costs

- 5 x FLO Core+ MAX 19.2 kW Level 2 chargers
- 3 x FLO Pedestal
- 4 x CoRe+ bracket side by side configuration
- 5 x FLO cable management system
- 5 x Global management service 1 year - Level 2 - $1,000.00 ($200 per charging head per year - the following covers maintenance and uptime)

Total: $36,925 + tax

Trenching - Lincoln Construction Group (independent 3rd party contractor)

- Excavate gravel to make room for new concrete pad
- Electrical conduit to be run beneath new pad by others when on site
- Supply, form and pour new 5 inch thick concrete pad approx 40x5
- Supply and install 6 bolt in place bollards around EV Station

Total: $10,820.00 + tax

Main Electrical Room material costs

- 1 x 150 kVa 120/208Y Transformer
- 1 x 200A Disconnect
- 1 x 400A electrical tub (to house the 5 new chargers)
- 1 x 12x12x4 PVC box (LTE/LAN Gateway)
- #3 wiring
- 2 x labour
- 2 x ESA Permits and inspections / trenching permit

Total: $21,485 + tax

Totals combined: **$69,230 + tax**

Level 3 - 50kW option available without requiring a service upgrade

- I know a Level 3 charger is not part of the scope for 2024 however it was requested so I am going to provide additional costs for 1 x Level 3, 50kW SmartDC charger.
- There is currently capacity for a 1 x 50kW SmartDC Level 3 charger, you would just have to reduce the number of Level 2 19.2kW chargers in order to accommodate the Level 3 charger.
- If you do decide to proceed with 1 x Level 3 charger we will have to increase the concrete slab size slightly to accommodate all the Level 2 and Level 3 chargers.

<u>SmartDC 50kW FLO - Level 3 hardware costs</u>

- 1 x SmartDC V3, 50kW, 480 Volts, SAE & CHAdeMO charging connectors - FLO - BLCE
- 1 x SmartDC V3 Base
- 1 x Prepaid maintenance services for one fast charging station SmartDC
- 1 x Global management service for one fast charging station SmartDC for 1 year
- 1 x Cable management for SmartDC V3, SAE & CHAdeMO charging connectors - BLCE (50kW only)

Total : $53,845.18 + tax

Main Electrical Room material costs - to be determined once we know how many Level 2's and how many level 3's

Figure 38: Level 2 - CoRe+ chargers + pedestal + bollards

Figure 39: Smart DC - 50 kW Level 3 FLO charger

<u>Service upgrade for the Operation Yard (2026)</u>

Service upgrade for 2026 - one thing to keep in mind for 2026, if the plan is to proceed with 3 x Level 3 chargers for 2026 you will definitely require a service upgrade.
Service upgrades usually take a year to complete so just keep that in mind as you will have to start initiating an upgrade about a year prior.

<u>Rec Plex - Requirement 1 x Level 2 charger (Core+ 19.2 kW FLO Charger)</u>

FLO Level 2 - Hardware costs

- 1 x FLO Core+ MAX 19.2 kW Level 2 chargers
- 1 x FLO Pedestal
- 1 x FLO Cable management system
- 1 x Global management service 1 year - $200 per year per charging head.

Total: $7,305 + tax

Trenching - Lincoln Construction Group (independent 3rd party contractor)

New EV Pedestal construction

- To trench approx 130ft from electrical room to new concrete pedestal location
- Trench to be excavated approx 2ft deep
- Excavate concrete and asphalt and dispose of material off site
- Electrician to be on site to run PVC for new EV station
- Backfill trench and compact
- Supply and install new 5 inch thick concrete pad for EV pedestal using 32C2 concrete
- Supply and install 2 concrete bollards
- Supply and install HL3 Surface Hot Mix Asphalt

Total: $16,720.00 + tax

Main Electrical Room material costs

- 1 x 45kVa Transformer
- 1 x 225amp panel
- 1 x 100amp breaker
- 1 x 12x12x4 PVC box (LTE/LAN Gateway)
- 1 x coil RW-90
- 2 x labour
- 2 x ESA Permits and inspections / trenching permit

Total: $13,150 + tax

Totals combined: **$37,175 + tax**

Town Hall - Requirement 1 x Level 2 charger (Core+ 19.2 kW FLO Charger)

FLO Level 2 - Hardware costs

- 1 x FLO Core+ MAX 19.2 kW Level 2 chargers
- 1 x FLO Pedestal
- 1 x FLO Cable management system
- 1 x Global management service 1 year - Level 2 - $200 per year per charging head.

Total: $7,305 + tax

Trenching - Lincoln Construction Group (independent 3rd party contractor)

New EV Pedestal construction

- To trench approx 80ft from electrical room to new concrete pedestal location

- Trench to be excavated approx 2ft deep
- Excavate concrete and asphalt and dispose of material off site
- Electrician to be on site to run PVC for new EV station
- Backfill trench and compact
- Supply and install new 5 inch thick concrete pad for EV pedestal using 32C2 concrete
- Supply and install 2 concrete bollards
- Supply and install HL3 Surface Hot Mix Asphalt

Total: $13,700 + tax

Main Electrical Room material costs

- Upgrade existing 100A panel to a new 250A panel to accommodate the new charger.
- Run 80ft of PVC 1.1/4 PVC pipe from the electrical room to the new pad being built in the parking area
- 1 x 12x12x4 PVC box (LTE/LAN Gateway)
- 1 x coil RW-90
- 2 x labour
- 2 x ESA Permits and inspections / trenching permit

Total: $8,900 + tax

Totals combined: $29,905 + tax

Evolute Power Building Capacity Reports:

Below is a breakdown of all the building capacity reports that Evolute Power delivered to the Town. The goal of these reports were to highlight the available electrical capacity at each location and determine the maximum number of L2 and/or L3 charging stations that can be installed before a service upgrade is required. The locations that were assessed are the Operations Yard, Rec Plex, Sports Park, Town Hall, and Fire Hall 1.

Evolute Power Building Capacity Report: Operations Yard

Date: 03-Jul-2024
Corp:
Address: 150 WESTBURY RD, WASAGA BEACH, ON, L9Z 0C8
Attention: PROPERTY MANAGER
Prepared by: Reet Malhi

Re: Electrical Investigation Report

- Evolute Inc. was granted permission to access the building and review drawings and hydro bills to evaluate the existing loads on the main electrical switchboard (SWBD). The goal of this report is to highlight available capacity and recommend the best cost-effective solutions for the Evolute™ Electric Vehicle Energy Management System (EVEMS)

- Existing electrical distribution system:
  The existing main incoming power is fed from a 170 kVA transformer. The primary incoming voltage is 120/208V 3P, 4W, located in the main electrical room on the P1 level.

- We have reviewed the Hydro bills provided for a total of 0 months, -
  This appears to be the Shared bills for the condo, as the overall consumption is high
  There may be other bills not captured in this report that may or may not be significant.

- Based on the maximum demand load of 53 kVA, there is spare capacity of 83 kVA @ 80% to add additional loads for future use. The demand load is 39% of the total available power, allowing the remaining unused power to be utilized for EV charging.

EXISTING ELECTRICAL SYSTEM CAPACITY - PEAK

Source	Max. capacity (kVA)	80% capacity (kVA)	Max. consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	170	136	53	83

QUANTITY OF CHARGING STATIONS BASED ON AVAILABLE POWER - PEAK

Description	Sharing Ratio	Total used power (kVA)	Maximum EV charging stations per panel	Maximum EV charging stations in total
EVOLUTE™	1:2	83	20 or 32	22
EVOLUTE™	1:3	83	20 or 32	33
EVOLUTE™	1:4	83	20 or 32	45

Dynamic Load Throttling Architecture Response System (EVO-DLTA) allows more charging stations to be installed than the peak capacity of the building can handle. EVO-DLTA monitors the main electrical service of the building and dynamically throttles down/up the Evolute's upper power limit during peak circumstances. All Evolute panels are networked together with Cat5 wiring, they communicate with each other, and throttle limits based on live active users. Once power in the building goes below the preset values, all Evolute panels will return to their default programmed

state.

The average and low demand loads are significantly lower than the peak, with the implementation of the EVO-DLTA system we can safely rely on the low and averages to implement a larger number of EV charging stations. One EVO-DLTA system will support all the panels in one building.

Source	Max. capacity (kVA)	80% capacity (kVA)	Average consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	170	136		136

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - AVERAGE

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.		136	20 or 32	37

EXISTING ELECTRICAL SYSTEM CAPACITY – LOW

Source	Max. capacity (kVA)	80% capacity (kVA)	Lowest consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	170	136		136

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - LOW

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.		136	20 or 32	37

Recommendations:

- Send out the Evolute survey form and establish how many owners are thinking of purchasing an EV or hybrid vehicle. The survey will highlight the location of these potential EV drivers and help determine the best locations for the Evolute panel(s).
- Arrange a site visit with one of our Project Managers to finalize the estimate and recommend the best possible location(s) that will service the greatest number of owners with the shortest conduit run to each location, reducing the overall costs, and enticing more owners to split the cost of the system(s)
- Install the recommended Evolute system(s) and permit Evolute Inc. to manage the entire billing and monitoring process on behalf of the Board and management. Third party billing is also an option as well as internal billing.

We trust that the information presented is clear and understood, should you have any questions, please do not hesitate to contact us for further discussion.

Evolute Power Building Capacity Report: Rec Plex

Date: 21-Jun-2024
Corp: RECPLEX
Address: 1724 MOSLEY ST, WASAGA BEACH, ON, L9Z 1Z7
Attention: PROPERTY MANAGER
Prepared by: Reet Malhi

Re: Electrical Investigation Report

- Evolute Inc. was granted permission to access the building and review drawings and hydro bills to evaluate the existing loads on the main electrical switchboard (SWBD). The goal of this report is to highlight available capacity and recommend the best cost-effective solutions for the Evolute™ Electric Vehicle Energy Management System (EVEMS)

- Existing electrical distribution system:
  The existing main incoming power is fed from a 450 kVA transformer. The primary incoming voltage is 347/600V 3P, 4W, located in the main electrical room on the G level.

- We have reviewed the Hydro bills provided for a total of 11 months, Feb- - Dec-
  This appears to be the Bulk bills for the condo, as the overall consumption is low
  There may be other bills not captured in this report that may or may not be significant.

- Based on the maximum demand load of 84 kVA, there is spare capacity of 276 kVA @ 80% to add additional loads for future use. The demand load is 23% of the total available power, allowing the remaining unused power to be utilized for EV charging.

EXISTING ELECTRICAL SYSTEM CAPACITY - PEAK

Source	Max. capacity (kVA)	80% capacity (kVA)	Max. consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	450	360	84	276

QUANTITY OF CHARGING STATIONS BASED ON AVAILABLE POWER - PEAK

Description	Sharing Ratio	Total used power (kVA)	Maximum EV charging stations per panel	Maximum EV charging stations in total
EVOLUTE™	1:2	276	20 or 32	74
EVOLUTE™	1:3	276	20 or 32	111
EVOLUTE™	1:4	276	20 or 32	148

Dynamic Load Throttling Architecture Response System (EVO-DLTA) allows more charging stations to be installed than the peak capacity of the building can handle. EVO-DLTA monitors the main electrical service of the building and dynamically throttles down/up the Evolute's upper power limit during peak circumstances. All Evolute panels are networked together with Cat5 wiring, they communicate with each other, and throttle limits based on live active users. Once power in the building goes below the preset values, all Evolute panels will return to their default programmed

state.

The average and low demand loads are significantly lower than the peak, with the implementation of the EVO-DLTA system we can safely rely on the low and averages to implement a larger number of EV charging stations. One EVO-DLTA system will support all the panels in one building.

Source	Max. capacity (kVA)	80% capacity (kVA)	Average consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	450	360	54	306

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - AVERAGE

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.	1:2	306	20 or 32	82

EXISTING ELECTRICAL SYSTEM CAPACITY – LOW

Source	Max. capacity (kVA)	80% capacity (kVA)	Lowest consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	450	360	29	331

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - LOW

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.	1:2	331	20 or 32	89

Recommendations:

- Send out the Evolute survey form and establish how many owners are thinking of purchasing an EV or hybrid vehicle. The survey will highlight the location of these potential EV drivers and help determine the best locations for the Evolute panel(s).
- Arrange a site visit with one of our Project Managers to finalize the estimate and recommend the best possible location(s) that will service the greatest number of owners with the shortest conduit run to each location, reducing the overall costs, and enticing more owners to split the cost of the system(s)
- Install the recommended Evolute system(s) and permit Evolute Inc. to manage the entire billing and monitoring process on behalf of the Board and management. Third party billing is also an option as well as internal billing.

We trust that the information presented is clear and understood, should you have any questions, please do not hesitate to contact us for further discussion

Evolute Power Building Capacity Report: Sports Park

Date: 03-Jul-2024
Corp:
Address: 1888 KLONDIKE PARK RD, WASAGA BEACH, ON, L9Z 2W8
Attention: PROPERTY MANAGER
Prepared by: David Ackermann

Re: Electrical Investigation Report

- Evolute Inc. was granted permission to access the building and review drawings and hydro bills to evaluate the existing loads on the main electrical switchboard (SWBD). The goal of this report is to highlight available capacity and recommend the best cost-effective solutions for the Evolute™ Electric Vehicle Energy Management System (EVEMS)

- Existing electrical distribution system:
  The existing main incoming power is fed from a 57 kVA transformer. The primary incoming voltage is 120/208V 3P, 4W, located in the main electrical room on the P1 level.

- We have reviewed the Hydro bills provided for a total of 0 months, -
  This appears to be the Shared bills for the condo, as the overall consumption is high
  There may be other bills not captured in this report that may or may not be significant.

- Based on the maximum demand load of 14 kVA, there is spare capacity of 32 kVA @ 80% to add additional loads for future use. The demand load is 31% of the total available power, allowing the remaining unused power to be utilized for EV charging.

EXISTING ELECTRICAL SYSTEM CAPACITY - PEAK

Source	Max. capacity (kVA)	80% capacity (kVA)	Max. consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	57	46	14	32

QUANTITY OF CHARGING STATIONS BASED ON AVAILABLE POWER - PEAK

Description	Sharing Ratio	Total used power (kVA)	Maximum EV charging stations per panel	Maximum EV charging stations in total
EVOLUTE™	1:2	32	20 or 32	8
EVOLUTE™	1:3	32	20 or 32	13
EVOLUTE™	1:4	32	20 or 32	17

Dynamic Load Throttling Architecture Response System (EVO-DLTA) allows more charging stations to be installed than the peak capacity of the building can handle. EVO-DLTA monitors the main electrical service of the building and dynamically throttles down/up the Evolute's upper power limit during peak circumstances. All Evolute panels are networked together with Cat5 wiring, they communicate with each other, and throttle limits based on live active users. Once power in the building goes below the preset values, all Evolute panels will return to their default programmed

state.

The average and low demand loads are significantly lower than the peak, with the implementation of the EVO-DLTA system we can safely rely on the low and averages to implement a larger number of EV charging stations. One EVO-DLTA system will support all the panels in one building.

Source	Max. capacity (kVA)	80% capacity (kVA)	Average consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	57	46		46

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - AVERAGE

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.		45.6	20 or 32	12

EXISTING ELECTRICAL SYSTEM CAPACITY – LOW

Source	Max. capacity (kVA)	80% capacity (kVA)	Lowest consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	57	46		46

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - LOW

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.		46	20 or 32	12

Recommendations:

- Send out the Evolute survey form and establish how many owners are thinking of purchasing an EV or hybrid vehicle. The survey will highlight the location of these potential EV drivers and help determine the best locations for the Evolute panel(s).
- Arrange a site visit with one of our Project Managers to finalize the estimate and recommend the best possible location(s) that will service the greatest number of owners with the shortest conduit run to each location, reducing the overall costs, and enticing more owners to split the cost of the system(s)
- Install the recommended Evolute system(s) and permit Evolute Inc. to manage the entire billing and monitoring process on behalf of the Board and management. Third party billing is also an option as well as internal billing.

We trust that the information presented is clear and understood, should you have any questions, please do not hesitate to contact us for further discussion.

Evolute Power Building Capacity Report: Town Hall

Date: 03-Jul-2024
Corp:
Address: 30 LEWIS ST, WASAGA BEACH, ON, L9Z 1A1
Attention: PROPERTY MANAGER
Prepared by: David Ackermann

Re: Electrical Investigation Report

- Evolute Inc. was granted permission to access the building and review drawings and hydro bills to evaluate the existing loads on the main electrical switchboard (SWBD). The goal of this report is to highlight available capacity and recommend the best cost-effective solutions for the Evolute™ Electric Vehicle Energy Management System (EVEMS)

- Existing electrical distribution system:
  The existing main incoming power is fed from a 115 kVA transformer. The primary incoming voltage is 120/208V 3P, 4W, located in the main electrical room on the P1 level.

- We have reviewed the Hydro bills provided for a total of 0 months, -
  This appears to be the Shared bills for the condo, as the overall consumption is high
  There may be other bills not captured in this report that may or may not be significant.

- Based on the maximum demand load of 56 kVA, there is spare capacity of 36 kVA @ 80% to add additional loads for future use. The demand load is 61% of the total available power, allowing the remaining unused power to be utilized for EV charging.

EXISTING ELECTRICAL SYSTEM CAPACITY - PEAK

Source	Max. capacity (kVA)	80% capacity (kVA)	Max. consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	115	92	56	36

QUANTITY OF CHARGING STATIONS BASED ON AVAILABLE POWER - PEAK

Description	Sharing Ratio	Total used power (kVA)	Maximum EV charging stations per panel	Maximum EV charging stations in total
EVOLUTE™	1:2	36	20 or 32	10
EVOLUTE™	1:3	36	20 or 32	15
EVOLUTE™	1:4	36	20 or 32	19

Dynamic Load Throttling Architecture Response System (EVO-DLTA) allows more charging stations to be installed than the peak capacity of the building can handle. EVO-DLTA monitors the main electrical service of the building and dynamically throttles down/up the Evolute's upper power limit during peak circumstances. All Evolute panels are networked together with Cat5 wiring, they communicate with each other, and throttle limits based on live active users. Once power in the building goes below the preset values, all Evolute panels will return to their default programmed state.

The average and low demand loads are significantly lower than the peak, with the implementation of the EVO-DLTA system we can safely rely on the low and averages to implement a larger number of EV charging stations. One EVO-DLTA system will support all the panels in one building.

Source	Max. capacity (kVA)	80% capacity (kVA)	Average consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	115	92		92

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - AVERAGE

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.		92	20 or 32	25

EXISTING ELECTRICAL SYSTEM CAPACITY – LOW

Source	Max. capacity (kVA)	80% capacity (kVA)	Lowest consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	115	92		92

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - LOW

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.		92	20 or 32	25

Recommendations:

- Send out the Evolute survey form and establish how many owners are thinking of purchasing an EV or hybrid vehicle. The survey will highlight the location of these potential EV drivers and help determine the best locations for the Evolute panel(s).
- Arrange a site visit with one of our Project Managers to finalize the estimate and recommend the best possible location(s) that will service the greatest number of owners with the shortest conduit run to each location, reducing the overall costs, and enticing more owners to split the cost of the system(s)
- Install the recommended Evolute system(s) and permit Evolute Inc. to manage the entire billing and monitoring process on behalf of the Board and management. Third party billing is also an option as well as internal billing.

We trust that the information presented is clear and understood, should you have any questions, please do not hesitate to contact us for further discussion.

Evolute Power Building Capacity Report: Fire Hall 1

Date: 29-Jul-2024
Corp:
Address: 966 RIVER RD, WASAGA BEACH, ON, L9Z 2K7
Attention: PROPERTY MANAGER
Prepared by: Reet Malhi

Re: Electrical Investigation Report

- Evolute Inc. was granted permission to access the building and review drawings and hydro bills to evaluate the existing loads on the main electrical switchboard (SWBD). The goal of this report is to highlight available capacity and recommend the best cost-effective solutions for the Evolute™ Electric Vehicle Energy Management System (EVEMS)

- Existing electrical distribution system:
  The existing main incoming power is fed from a 124 kVA transformer. The primary incoming voltage is 347/600V 3P, 4W, located in the main electrical room on the P1 level.

- We have reviewed the Hydro bills provided for a total of 0 months, -
  This appears to be the Commo bills for the condo, as the overall consumption is mediu
  There may be other bills not captured in this report that may or may not be significant.

- Based on the maximum demand load of 42 kVA, there is spare capacity of 57 kVA @ 80% to add additional loads for future use. The demand load is 42% of the total available power, allowing the remaining unused power to be utilized for EV charging.

EXISTING ELECTRICAL SYSTEM CAPACITY - PEAK

Source	Max. capacity (kVA)	80% capacity (kVA)	Max. consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	124	99	42	57

QUANTITY OF CHARGING STATIONS BASED ON AVAILABLE POWER - PEAK

Description	Sharing Ratio	Total used power (kVA)	Maximum EV charging stations per panel	Maximum EV charging stations in total
EVOLUTE™	1:2	57	20 or 32	15
EVOLUTE™	1:3	57	20 or 32	23
EVOLUTE™	1:4	57	20 or 32	31

Dynamic Load Throttling Architecture Response System (EVO-DLTA) allows more charging stations to be installed than the peak capacity of the building can handle. EVO-DLTA monitors the main electrical service of the building and dynamically throttles down/up the Evolute's upper power limit during peak circumstances. All Evolute panels are networked together with Cat5 wiring, they communicate with each other, and throttle limits based on live active users. Once power in the building goes below the preset values, all Evolute panels will return to their default programmed state.

The average and low demand loads are significantly lower than the peak, with the implementation of the EVO-DLTA system we can safely rely on the low and averages to implement a larger number of EV charging stations. One EVO-DLTA system will support all the panels in one building.

Source	Max. capacity (kVA)	80% capacity (kVA)	Average consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	124	99		99

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - AVERAGE

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.		99.2	20 or 32	27

EXISTING ELECTRICAL SYSTEM CAPACITY – LOW

Source	Max. capacity (kVA)	80% capacity (kVA)	Lowest consumed power (kVA)	Available power @ 80% (kVA)
Main SWBD	124	99		99

QUANTITY OF SMART PANELS BASED ON AVAILABLE POWER - LOW

Description	Sharing Ratio	Total used power (kVA)	Max. EV charging stations per panel	Max. EV charging stations in total
EVOLUTE™ with DLTA*R.S.		99	20 or 32	27

Recommendations:

- Send out the Evolute survey form and establish how many owners are thinking of purchasing an EV or hybrid vehicle. The survey will highlight the location of these potential EV drivers and help determine the best locations for the Evolute panel(s).
- Arrange a site visit with one of our Project Managers to finalize the estimate and recommend the best possible location(s) that will service the greatest number of owners with the shortest conduit run to each location, reducing the overall costs, and enticing more owners to split the cost of the system(s)
- Install the recommended Evolute system(s) and permit Evolute Inc. to manage the entire billing and monitoring process on behalf of the Board and management. Third party billing is also an option as well as internal billing.

We trust that the information presented is clear and understood, should you have any questions, please do not hesitate to contact us for further discussion.

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