GREEN FLEET STRATEGY ACTION PLAN

Item	Recommendations	Implementation Timelines	Statement	Cost Impacts	GHG	Progress
1	Follow a historical data-driven lifecycle cost assessment, which is completed by modelling repair, maintenance, fuel, and cost of capital over the vehicle's entire lifecycle to determine the optimal replacement age of vehicles.	Previously Implemented/ Immediate	Previously Implemented: Fleet's current process for determining the optimal replacement age of an asset takes into consideration factors such as high maintenance cost, kilometres and replacement year. Immediate: Fleet will utilize the tools provided by Richmond Sustainability to enhance how data is analyzed. Applying this methodology will establish a more accurate approach to determining the optimal replacement cycles for each fleet classification	Costs will be monitored. Impacts to both capital and operating costs are possible	This recommendation may result in shorter or longer replacement cycles. GHG reduction will be impacted by changes in replacement cycles	Utilized in 2021. Working with the data to streamline the process for generation of reporting.
2	Consider implementing the green fleet asset management best practices recommended by RSI-FC as illustrated in the process flow chart (Page 25). With these processes the fleet will become green and right-sized.	Previously Implemented/ Immediate	Previously Implemented: Fleet will continue to communicate with the operating departments in determining fit for purpose assets and advise on the availability of BEV assets. Immediate: Fleet will focus on becoming green and right-sizing the fleet by following the recommended best practices identified in the process flow chart (Page 25). Fleet will identify criteria to establish: what the corporate minimum will include, roles and responsibilities and determine what operational justification and level of authorization is required to go outside the corporate minimum	Costs will be monitored. Impacts to both capital and operating costs are possible	GHG reduction will be impacted by determined replacements	Fleet has utilized Richmonds Process Flow Chart for Optimized Green Fleet Planning as a template and created a City of Hamilton specific process flow
3.1	1) Employ a total cost of ownership (TCO) approach to optimize the use of capital.	Previously Implemented/ Immediate	Previously Implemented: Currently the driving factor when considering replacement is high maintenance cost Immediate: Fleet will apply the tools provided by RSI to enhance how TCO is calculate and apply a data driven approach to optimize the use of capital	Costs will be analyzed by utilizing the tools provided by RSI. Impacts to both capital and operating costs are possible	GHG reduction will be impacted by determined replacements	Current data is not sufficient to provide accurate TCO for the variety of vehicle classifications. 1.We've identified areas that the new maintenance management system will improve the data collection process to support the required accuracy level of a TCO calculation 2.Yards study recommendations will allow for consolidation of fleet operation where data entry will be consistent and accurate.
3.2	2) Consider Total Cost of Ownership(TCO) in competitive bidding proposal structures instead of the lowest compliant bid approach.	Long Term	TCO Procurement- Review in consultation with Procurement and align to the procurement bylaw. This approach provides a narrow view of costs associated with the initial purchase of an asset and factors such as planned maintenance. However, many variables with respect to unplanned work will need to be considered to confidently build this concept into the bidding process while remaining fair and transparent	No direct cost impacts associated with the implementation of this recommendation	No direct GHG reduction impacts associated with the implementation of this recommendation	
4	Create an education piece for idling reduction, operating efficiently, and reducing fuel consumption.	Immediate	Creation of posters for display in common areas. Have stickers made up for dashboards in vehicles. Create communication for display on monitors	Minimal	Reduction to GHG's specific to improved driver behaviours will be difficult to determine however it is a generally accepted principal that driver behaviours and awareness as they contibute to fuel consumption will result in favourable changes to fuel economy.	Through corporate comminicatins, designs have been developed and approved. Material for distribution and posting are expected in Fall 2022
5	Add a driver eco-training module to existing Professional Driver Improvement Course (PDIC) safe driver training and consider eco-driver training for all drivers.	Immediate	Compliance section has added an anti-idling segment to the Driver Safety & Compliance Manual Training presentation. Met with the provider used to update our Driver Improvement Course content to include an eco driving segment. We can purchase an update to our program that contains a module which is approx. 50 minutes in length.	$3,000	Reduction to GHG's specific to improved driver behaviours will be difficult to determine however it is a generally accepted principal that driver behaviours and awareness as they contibute to fuel consumption will result in favourable changes to fuel economy.	Eco driver training course was implemented in September 2021 and to date approximately 300 employees have taken the training.
6	Measure and track fuel consumption and GHGs at the Department/Division/Section/Group levels to track progress and set tangible goals.	Immediate	Staff will develop an ongoing fuel usage report to calculate total GHG's by Department/Division/Section/Group level and vehicle classification.	No direct cost impacts associated with the implementation of this recommendation	No direct GHG reduction impacts associated with the implementation of this recommendation	Anti-Idling report developed with the assistance of AVL provider. Consumption report in development for Department/Division/Section/Group level and vehicle classification. Confirming accuracy of benchmark data.
7	Modernize and/or retrofit Fleet facilities to obtain LEED certification.	Long Term	Will seek oppurtunities to implement as part of the Non-Public Facing Yards Review	Unknown at this time	Unknown at this time	
8	Invite frontline employees to take BEV test drives to build an affinity towards electric vehicles.	Previously Implemented	Fleet schedules demonstrations to remain current with the industry and an opportunity for operating departments to test new technology and provide feedback. Since 2019 Fleet has arranged demonstrations of the following BEV units: Chevy Bolt EV, Kina Niro EV, Hyundai Ionic EV, Kia Soul EV, Mitsubishi PHEV, Toyota Hybrid. Fleet will continue to arrange demonstrations and communicate new technologies to the operating departments	No direct cost impacts associated with the implementation of this recommendation	No direct GHG reduction impacts associated with the implementation of this recommendation	

GREEN FLEET STRATEGY ACTION PLAN

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9	If possible, avoid buying Internal Cumbustion Engine replacement vehicles until suitable BEVs become available.	Immediate	If possible, Fleet will avoid procuring ICE replacement vehicles until suitable BEVs become available. Fleet is recommending deferring ICE replacements for a maximum of two (2) years in the classifications where BEVs will be available within this timeframe. Fleet will provide options to the User Groups such as 1) rental units 2) short term leases 3) extended use (dependent on availability). However, as stated in recommendation 2 Fleet will identify criteria to establish: what the corporate minimum will include, roles and responsibilities and determine what operational justification and level of authorization required to go outside the corporate minimum	Cost impacts will result in increase to operating budgets (lease/rentals).	GHG reduction will be impacted by determined replacements. For each gas powered vehicle replaced with a BEV the GHG reduction per unit will be approximately •SUV: 3 tonnes annually •1/2 ton Pick Up: 5 tonnes annually	Fleet is adjusting vehicle replacements to align to classifications of electric vehicles currently available on the market. To remain on target with the commitments stated in the Green Fleet Strategy, Fleet has created an electric vehicle purchase strategy with a focus on replacement vehicles being electric as long as there is a fit for purpose vehicle on the market. If a BEV is not an option or not available the replacement vehicle shall be the lowest GHG option on the market meeting operational requirements.
10	Strictly through a lens of fiscal planning, prioritize replacement of units with BEVs only if they would deliver return-on-investment (ROI).	Additional Analysis	Fleet will review and develop replacement criteria that will consider a return-on-investment strategy along with other impacts such as GHG reductions, manufacturers build schedules and available charging infrastructure.	Costs will be monitored. Impacts to both capital and operating costs are possible	GHG reduction will be impacted by determined replacements	The cost impacts include fuel prices and vehicle prices. As these factors continue to change quickly we will continue to monitor these costs to do a accurate periodic assessments.
11	Allocate capital for charging infrastructure in the near-future to meet the demand in the mid- to long-term.	Immediate	Based on the BEV replacement schedule Fleet Planning worked with the operating departments to determine appropriate charging locations. To provide charging stations to the 89 scheduled purchases of BEV's city staff are recommending 47 Level 2 Charging stations and 2 Level 3 charging stations. Fleet will partner with City Departments (IT, Energy Initiatives) to determine appropriate procurement method for short term and long-term supply. Ensure system will have the ability to communicate with various software platforms and have the capability to accommodate light/medium and heavy-duty fleet	Supply and installation of all 49 stations is expected to cost $593,000.00. Successful Grant funding application will reduce this amount by 50%	Based on historical average annual fuel consumption the city can realize a reduction of 335 tonnes of GHG's by replacing all 89 vehicles with a BEV option	Fleet was successful in securing funds through the NRCAN grant application which will contribute 50% of the project cost. Fleet has identified hub locations to install the infrastructure which aligns to vehicle replacements and is finalizing the supply and install agreement with the charging station provider.
12	Consider adopting the Richmond Sustainability's -Fleet Challenge recommended lifecycle analysis (LCA) approach to extract maximum value from each vehicle.	Immediate	By utilizing the Lifecycle Analysis tools provided by RSI-FC this will provide a component not previously available to Fleet Planning. The tool will provide algorithms using the RSI database resulting in enhanced accuracy in predicting optimal vehicle lifecycles and the ability to analyze/predict maintenance costs past a vehicles current expected life. Leveraging this tool will allow Fleet to schedule replacements prior to spikes in maintenance and downtime.	Costs will be monitored. Impacts to both capital and operating costs are possible	GHG reduction will be impacted by determined replacements. Affects could be mixed as a result of extending or reducing replacement cycles	Challenges with data population has not allowed for full use of this tool. We are working on developing data implementation tools that we can use going forward.
13	Consider balancing go-forward capital budgets as part of Long Term Capital Planning by deferring replacement of any units evaluated as being in above average, serviceable condition to later fiscal years.	Additional Analysis	Fleet will consider a balance go forward capital replacement approach utilizing evaluation based criteria. Fleet will create a defined process that will include a ranking system, defined evaluation criteria, how it will be reported and applied to asset replacements	No direct cost impacts associated with the implementation of this recommendation	No direct GHG reduction impacts associated with the implementation of this recommendation	Our current maintenance management system does not have the functionality to support the requirements of this recommendation. We intend on noting this requirement in the new mms.
14	When the fleet's average age and uptime rates are determined to be at acceptable levels, consider re-investing in the fleet at the rate of depreciation.	Additional Analysis	Further analysis is required for this recommendation. Several factors to consider when addressing average age and uptime rates such as: acquiring newer vehicles or ensuring there is a highly-effective preventive maintenance (PM) program is in place. EAM system is expected to provide additional tools which will give Fleet the ability to address this recommendation	Additional analysis required to show impacts to capital and operating budgets	No direct GHG reduction impacts associated with the implementation of this recommendation	subject to EAM implementation
15	Consider job suitability of vehicles before proceeding with light weighting enhancements.	Previously Implemented	Fleet currently and will continue to work with the operating departments to develop an understanding of the operational needs when developing specifications for replacement assets. Fleet provides recommendations to ensure the assets are fit for purpose, downsize where possible and investigate lighter weight materials used in asset construction (i.e.: changing steel trailers to aluminum). Fleet will continue to research light weighting enhancements by staying in contact with manufacturer reps, virtual trade shows and communication with other municipalities	Costs will be monitored. Impacts to both capital and operating costs are possible	GHG will be difficult to determine however it is a generally accepted principal that lighter vehicles will contribute to favourable fuel economy.	
16	In conjunction with driver training, consider route planning software, idling reduction initiatives and maintenance checks by integrating GPS tracking software to monitor driver activity and fuel consumption.	Additional Analysis	Met with our Automated Vehicle Location(AVL) provider and they are looking into different options that may be available for monitoring driver activity & fuel consumption	Unknown at this time	Reduction to GHG's specific to improved driver behaviours will be difficult to determine however it is a generally accepted principal that driver behaviours and awareness as they contribute to fuel consumption will result in favourable changes to fuel economy.	initial discussions with avl provider identified areas where product development will provide the data needed. Working towards a solution.0
17	Consider a fuel-efficient driver incentive program in which drivers are incentivized to improve behaviours or reduce their travel.	Additional Analysis	This type of program may be difficult to implement. Monetary incentives would be costly. Determining who would receive any incentives may be challenging to ensure equality.	Unknown at this time	Unknown at this time	

GREEN FLEET STRATEGY ACTION PLAN

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18	E85 Usage Consider the challenges associated with switching to E85, including supply, any additional infrastructure costs, and whether the potentially greater fuel cost is financially prudent. Should the City proceed with this solution, consider a pilot project with several units switched to E85 at first, and if successful a phased-in approach for other appropriate units	Additional Analysis	This recommendation will require installation of dedicated fuel storage tanks for this fuel type. Analysis required to decide where and how many tanks will be required to accommodate reasonable accessibility by the vehicles currently capable of using this fuel type. E85 contains about 27% less energy than gasoline per unit volume. Given this energy loss, about 37% more E85 is required to achieve the same amount of work as gasoline. Also need to consider cold weather ignition challenges.	Estimated 16% costlier that conventional gasoline, capital fuel storage tanks and dispenser infrastructure costs	4% reduction when compared to energy equivalent of gasoline	The data to determine cost of tanks and fuel site upgrades has been collected. Automotive market for new vehicles continues to be unstable and availability of E85 vehicles are scarce. We will continue to monitor the market however this option is not recommended at this time.
19	Biodiesel Some precautions must be taken before making the switch to biodiesel, including using a lower blend due to viscosity issues at cold temperatures. We recommend using a blend of 5% in winter and 20% in the summer and shoulder months. Consider a pilot project with several units switched to B10 at first, and if successful a phased in approach for other appropriate units.	Immediate	Trial of 20% blend for the summer and a 5% blend for the winter in two locations for one year.	Minor cost to perform due diligence service to fuel storage tanks and dispensers	Average annual GHG reductions expected to be between 10-12%	Reduced GHG's by 106 tonnes as a result o biodiesel use in 2021. Concerns realized during the winter season use of the B5 blend that will prevent future use of Biodiesel during cold weather months. The summer use of B20 did not present any challenges and we anticipate city wide use of B20 by the end of this summer.
20	CNG If CNG is of interest to the City, we recommend investigating subsidies for CNG upgrades and a CNG vehicle fuelling station. Consider a small-scale pilot project with several high-mileage units switched to CNG, and if successful a phased-in approach for other appropriate units	Additional Analysis	This recommendation will require installation of natural gas compressor stations. The infrastructure required for a Natural gas refuelling stations along with the mandated periodic maintenance and inspections are costly resulting in an increase to capital and operating budgets. Converting to natural gas on a large scale will require several fuelling stations throughout the City to accommodate reasonable accessibility for refuelling. The possibility of concentrated areas of natural gas vehicles with a short term refuelling equipment lease or "pay per use" arrangement may have some benefit for a short term until electric or other more efficient options become available.	Diesel Litre Equivalent cost difference is 75% less. CNG compressor station can cost between $2-4 million depending on volume and flow requirements	Approximately 17% reduction compared to Diesel	The data to determine cost of compressors and storage tanks has been collected. Additional investigation into "fuel as a service" option was analysed. Currently in process of finalizing specifications for natural gas powered waste collection trucks. The lead time for natural gas powered chassis is 1-2 years with final completion of truck up to 2.5 years away. Typical builds were 9month-1 year.
21	Liquified Petroleum Gas(LPG) aka Propane If a strong business case for LPG can be shown for high-mileage units, consider a small scale pilot project with several high-mileage units switched to LPG, and if successful a phased-in approach for other appropriate units.	Additional Analysis	This recommendation will require installation of Propane dispensing stations. The infrastructure required for a Propane stations along with the mandated periodic maintenance and inspections are costly resulting in an increase to capital and operating budgets. Converting to Propane on a large scale will require several fuelling stations through the City to accommodate reasonable accessibility for refuelling.	A propane fuelling station is approximately $15,000	Approximately 30% reductions compared to gasoline	This option requires a fairly significant capital investment for widespread use. The configuration of vehicles that would be considered for conversion to propane power are currently available in fully electric albeit in lower quantities than anticipated. It is Fleets recommendation to continue to source fully electric vehicles rather than converting vehicles to Propane.
22	Consider a pilot project for several BEVs when they become available (e.g., pickups) to track range capabilities and cost Immediate & short-term savings and assess the units' performance for all seasons and varying weather conditions. Assuming the pilot project is successful, consider acquiring BEVs in bulk to replace units that would provide the greatest ROI.	Previously Implemented/ Immediate	Previously Implemented: Licensing & By-law Services is currently piloting two (2) Kia Souls EV. Immediate: Fleet has drafted a 3 year forecast of 89 vehicles that can be replaced with BEV's and will be replaced as scheduled. Fleet will continue to investigate and survey the market for availability of demo models as new BEVs become available.	Two wheel drive SUV's are the only BEV's currently being sold. The cost increase is approximately 60% more than a gas powered SUV.	Based on historical average annual fuel consumption the city can realize a reduction of 335 tonnes of GHG's by replacing all 89 vehicles with a BEV option	
23	Continue to closely monitor the acquisition costs for BEVs and re-evaluate the business case (cost-benefit) for individual units as prices come down. Also continue to monitor the future availability of electric work/cargo vans, which are currently anticipated to be offered in battery-electric versions in the near future.	Previously Implemented	Fleet will continue to regularly monitor the industry and meet with manufacturer representatives annually for an update on estimated pricing, configurations and BEV release dates into the market. Fleet will utilize this information when preparing the capital budget annual replacement	Costs will be monitored. Impacts to both capital and operating costs are possible	GHG reduction will be impacted by determined replacements	
24	If relying on overnight charging infrastructure, consider supplying power to the charging equipment on two separate feeds from the grid to reduce the risk of local failure taking power away from the whole site.	Long Term	This recommendation will require further analysis and alignment to the yard rationalization review	No direct cost impacts associated with the implementation of this recommendation	No direct GHG reduction impacts associated with the implementation of this recommendation	

GREEN FLEET STRATEGY ACTION PLAN

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25	Consider high-voltage training for technicians and closely monitor the launch of new BEV training programs.	Short Term	Staff will research available high voltage training.	This could impact both the operating budget as well as the capital. Operating budget impacts for training courses $1000/Technician. Possible diagnostic tooling and equipment's costs.	No direct GHG reduction impacts associated with the implementation of this recommendation	
26	Hydrogen Fuel Cell Summary Fuel cell technology has a very high potential for future applications for vehicles in all classes. Nevertheless, the technology currently is still very expensive, lifecycle emissions are high and Fuel Cell Vehicles (FCVs) as well as fuelling stations are not yet available. As a result, any projections of fuel cell application in the future must be approached with caution and understanding of the inherent limitations. Therefore, it is recommended that a fleet monitor the development and availability of fuel cell technology for future applications in fleet operations	Additional Analysis	Currently there are very limited number of vehicles available to consider hydrogen as a viable option. Additionally refueling infrastructure does not exist in the City of Hamilton and a large scale implementation would be required to show a reasonable ROI to fund the refuelling infrastructure. Other challenges include repair facility infrastructure and support.	Capital cost for refuelling infrastructure is estimated to be in excess of $2 million per site.	Currently most if not all hydrogen is produced from the burning of fossil fuels known as "Grey Source". Hydrogen from "Grey Sources" will have little to negative impacts to GHG's. Future hydrogen is expected from solar or wind "Green Source" which will show a favourable impact to GHG's	The data to determine cost of a hydrogen fuel station varies significantly by region. The lack of experienced trades in this region would make a firm budget estimate challenging and the securing of a qualified vendor a significant challenge. The Automotive market for new vehicles continues to be unstable and availability of hydrogen vehicles in Canada is scarce. We will continue to monitor the market however this option is not recommended at this time.
27	Renewable Natural Gas	Additional Analysis	A City wide strategy will be developed and implemented by Energy for the best use of RNG across City assets and operations.	Natural Gas compressor stations can cost between $2-4 million depending on volume and flow requirements	Use of RNG is determined to have net zero impact to GHG's	Cost and availability are contributing factors however at this time we do not have any natural gas vehicles for which Fleet supplies fuel. The pending purchase of natural gas powered waste collection vehicles will allow for a more detailed cost analysis. Scheduled for 2023-2024
28	Rolling Resistance	Additional Analysis	This recommendation requires further analysis and testing. Fleet will consider including this technology in contract documents for new replacement vehicles where applicable. Further Analysis and involvement from tire provider and possible pilot on various types of vehicles and weather conditions to establish baseline	Exact cost associated with technology can not be directly identified. Cost benefit analysis will be performed on a case by case basis	Each solution will vary in its magnitude of GHG reductions, it is generally accepted that any reduction in rolling resistance will have a direct impact on GHG's reduction	Initial discussion with new tire supply vendor in September 2021. Considering test group of vehicles for a pilot program through all four seasons to determine benefits.
29	RSI-FC recommends expert legal review of the Electronic Logging Device(ELD) matter prior to the June 2021 deadline	Previously Implemented	Contacted Ministry of Transportation to confirm ELD's are not required for our Fleet as we are exempt from using logs to capture hours of service as a municipality that operates within a 160 km radius and we do not cross any borders.	None	None	
30	Anti-Idling Technologies	Previously Implemented/ Additional Analysis	Previously Implemented: Anti-Idling technology is currently being utilized in accessories installed in Fleet assets such as cab heaters, inverters, shut down systems, LED lights. Additional Analysis: Fleet will continue to investigate technology to aid in anti idling to determine the optimal solution and process for educating operating departments	Exact cost associated with technology can not be directly identified. Cost benefit analysis will be performed on a case by case basis	Each solution will vary in its magnitude of GHG reductions. Any reduction in idling will have a direct impact on GHG's reduction	

Previously Implemented
Immediate less than 1 year
Short Term 1-3 years
Long Term 3 years +
Additional Analysis Required