CITY OF VICTORIA

City of Victoria
Green Fleet Plan

December 2021

Developed with support from Cascadia Partners
and AES Engineering

www.cascadiapartners.ca

www.aesengr.com

Table of Contents

Executive Summary 4
Introduction 7
Background & Context 7
Research and Analysis 7
Current Fleet Assessment 7
Fleet Replacement Scenario Analysis 10
Fleet Electrification Approach 10
Capital Investment Strategy 15
Preferred Fleet Capital Investment Strategy 15
Electric Vehicle Charging Infrastructure Investment Strategy 17
Electrical Vehicle Infrastructure Expansion Plan 2022 - 2027 18
Fleet Management Processes 22
Vehicle Replacement Process & Lifecycle 22
Vehicle Procurement Strategy Considerations 23
General Observations 25
Performance Management Plan 27
Usage Measures 27
Underperforming Replacements 28
Lifecycle Management & Carbon Reduction 29
Recommendations Summary 30
Strategic Alignment 35
Appendix A - Engagement Summary 36
Best Practices Review 38
Appendix B – Vehicle Electrification Business Case Model 42
Appendix C – Priority Replacement Vehicles 45
Appendix D – Low Utilization Assets 48
Appendix E – New Vehicle Replacement Policy 49

Executive Summary

To substantially reduce the risks and effects of climate change, scientists and policy makers have come to the agreement that global society must stabilize and reduce greenhouse gas (GHG) emissions to levels that limit global temperatures from rising beyond 1.5°C over the next 30 years. This translates to reducing GHG emissions by 50% by 2030 and more than 80% by 2050.[1]

On this basis, the City of Victoria (the City) has developed the Climate Leadership Plan (CLP) and set aggressive corporate climate targets requiring a 60% reduction of GHG emissions by 2030 and 80% by 2050 within a triple bottom line accounting system. The City has also set a 100% renewable energy target for 2050, meaning that all fuels consumed are renewable and, ultimately, have low carbon footprints. This Green Fleet Plan is another initiative that will help the City address the climate crisis by becoming a leader and early adopter of electric vehicles within their fleet, and compliments other efforts underway including the Corporate Energy and Emissions Management Plan (CEEMP) and the Electric Vehicle and Electric Mobility Strategy.

Cascadia Strategy Consulting Partners (Cascadia Partners) was contracted by the City to develop the Green Fleet Plan to evaluate fleet electrification and the role of renewable vehicle fuels. The primary objectives are to develop actions, policies, and capital investment guidelines to 2025, with higher level guidance supporting long term actions and investments to 2030.

Fleet electrification is central to the Green Fleet Plan as the most sustainable way to transition away from burning fossil fuels for transportation. In a region such as British Columbia, where renewable and reliable electricity is readily available shifting to renewable fuels, such as biodiesel, would be a stop-gap measure. There are also environmental and social issues associated with the production and shipping of renewable fuels long distances. Lastly, capital invested in fueling infrastructure for renewable fuels would be better used to invest in charging infrastructure, much of it permanent City fixtures.

To complete this work, Cascadia Partners held fleet workshops with the Core Fleet Team[2] with representation from multiple City departments, including Engineering, Transportation and Public Works, Parks Recreation and Facilities, Victoria Fire Department, Corporate Services (Finance) and Victoria Police Department (VicPD) The workshop content varied by audience, but generally focused on gathering a greater understanding of the operational needs of department fleet vehicles, seeking input on potential fleet management initiatives seen elsewhere, and discussing the suitability of electrifying fleet assets or using alternative fuels.

In parallel, Cascadia Partners developed an electric vehicle (EV) business case model with key utilization and fuel consumption metrics for each fleet vehicle to identify and prioritize assets for electrification. The fleet electrification approach prioritizes vehicles with a positive financial business case and accounts for market readiness of pending technology for specific vehicle types. Optimized to target a reduction of 706 tonnes of GHGs emissions by 2030, 143 vehicles were identified with a capital cost premium[3] of approximately $5.8 million and lifecycle savings of $1.9 million (see Table E1)

[1] https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf
[2] The Core Fleet Team includes the Public Works Manager, Fleet Asset Management Project Coordinator, and the Fleet Business Analyst. There are also fleet managers for Victoria Police and the Fire Department.
[3] Premium of purchase price of an electric vehicle versus a traditionally fuelled alternative.

Table E1 Fleet Capital Investment Summary

Year	Capital	Vehicles Procured	EVs Procured	Carbon Reduction (Tonnes GHG)	Gap to Goal (Tonnes GHG)
*2022	-$5,833,000	33	21	95	612
2023	-$3,811,250	43	18	73	539
2024	-$6,446,575	46	23	97	441
2025	-$4,007,688	29	20	53	388
2026	-$5,737,915	28	15	60	329
2027	-$3,157,089	41	13	71	257
2028	-$3,847,617	18	12	121	137
2029	-$3,611,701	14	9	40	96
2030	-$5,141,247	29	12	97	0
Total	-$41,594,081	281	143	707	-

A functioning fleet electrification planning model is provided as Annex 1 to this report.

To support the electrification of these vehicles, a full EV charging infrastructure plan was developed by AES Engineering. The plan, developed to include public charging investments as part of the Electric Vehicle and Electric Mobility Strategy, estimates a total required investment of approximately $3.2 million in charging infrastructure at City facilities by 2027. Electrical single line diagrams and a more in-depth infrastructure cost estimate (by site) is provided as Annex 2 and Annex 3 to this report, respectively.

In meeting with various departments across the City, reviewing fleet processes, and planning for the future of the fleet, the following primary recommendations and associated actions were identified:

1. **Investments in an Electrified Fleet:** With the stated goals of reducing carbon emissions, fuel, and maintenance costs, and improving the reliability of the fleet, the Green Fleet Plan provides a roadmap for fleet electrification including prioritized assets for replacement and charging infrastructure upgrades. There is a first mover advantage to being proactive in identifying new EV candidates and reserving EVs or joining waitlists with manufacturers in advance.

2. **Revised Fleet Policies and Processes:** To support the transition to a cleaner fleet, extend vehicle lifecycles, and reduce the overall fleet size, there are a number of key actions for consideration. This includes an operational requirements review to right-size vehicles for use; vehicle standardization to improve purchasing, maintenance, and transitioning to EVs; and creating or revising several carbon policies to increase alignment across the City, including the Victoria Police Department (VicPD).

3. **Fleet Technology and Resources:** There is a need to improve data collection, analysis, and planning capacities within the Core Fleet Team[4]. This can be completed by hiring a dedicated Fleet Analyst / Fleet Planner, enhancing the fleet GPS and telematics system, and expanding EV training and knowledge to the maintenance teams in the Core Fleet and the Fire Department.

[4] The Core Fleet Team includes the Public Works Manager, Fleet Asset Management Project Coordinator, and the Fleet Business Analyst. There are also fleet managers for Victoria Police and the Fire Department.

4. **Increase Fleet Efficiency:** There are several initiatives that can optimize the remaining fleet, including the emissions of vehicles that cannot be transitioned to electric at this time. Some key actions in this area would be to improve shared vehicle use, reduce non-productive idling, and leverage renewable fuels.

The above initiatives will be primarily underpinned by a revised vehicle procurement and replacement process that will put the objectives of the Green Fleet Plan at the forefront of capital planning. To further clear the way for fleet electrification, the long-term fleet capital plan should be adopted to guide the annual budget process. This prioritizes the Green Fleet Plan and protects it from budget cuts due to emissions savings realized elsewhere in City operations. This recommendation is in line with the approach taken by other cities such as Vancouver.

Introduction

To substantially reduce the risks and effects of climate change, scientists and policy makers have come to the agreement that our global society must stabilize and reduce GHG emissions to levels to limit global temperatures from rising beyond 1.5°C over the next 30 years. This translates to reducing GHG emissions by 50% by 2030 and more than 80% by 2050.[5]

To align with these recommendations, the City has developed the Climate Leadership Plan and set aggressive corporate climate targets requiring a 60% reduction of GHG emissions by 2030 and 80% by 2050 within a triple bottom line accounting system. The City has also set a 100% renewable energy target for 2050, meaning that all fuels consumed are renewable.

The City of Victoria operates a large fleet of 400 vehicles and hundreds of pieces of equipment: the majority burn fossil fuels. The City is transitioning away from fossil to renewable fuels as outlined in the CLP, this Green Fleet Plan focuses on the transition of fleet vehicles.

The goal of the Green Fleet Plan is to achieve reductions in fleet GHG emissions, consistent with meeting the targets of the Corporate Energy and Emissions Plan. To meet this target, at least 706 tonnes of annual GHG emissions must be removed from fleet operations by 2030. The Green Fleet Plan uses electrification as its central approach to achieving these emission reductions and uses an investment optimisation approach to help offset capital investment in an electrified fleet with operating saving gains. These savings, once realized, may be redeployed to electrify other fleet assets, including some with a negative business case, however, this is not needed until much later in the transition away from fossil fuels.

Background & Context

Cascadia Partners was contracted by the City to develop a Green Fleet Plan to evaluate fleet electrification and the use of renewable fuels. The primary objectives of the Green Fleet Plan are to develop actions, policies, and capital investment guidelines to 2025, with higher-level guidance supporting long-term actions and investments to 2030. Cascadia Partners has experience with completing similar plans for several other municipalities and brings a refined vehicle business case model for evaluating fleet usage and identifying emissions reductions for individual assets.

Cascadia met with various City departments to complete a current state assessment of fleet utilization, identify challenges with EV adoption, and to identify opportunities for electrification in each departmental fleet. The team further discussed opportunities to improve policies and procedures to increase fleet efficiency at the City. A summary of fleet recommendations is available in the section titled Fleet Management Process Recommendations.

Research and Analysis

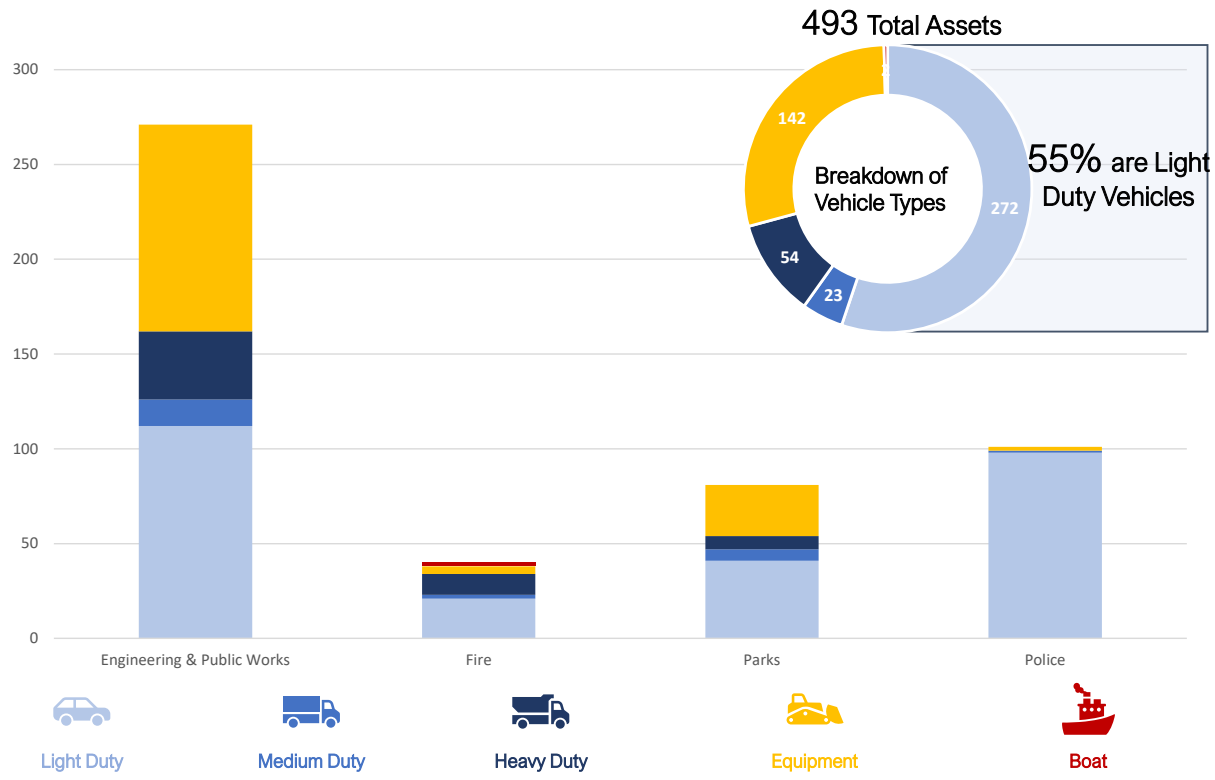
CURRENT FLEET ASSESSMENT

The fleet at the City of Victoria is centrally managed and follows regular budgeting and procurement practices with a few notable exceptions. First, the Victoria Police Department oversees the procurement of their own fleet vehicles, both administrative and patrol, although maintenance is still overseen by the Core Fleet Team. Second, the Fire Department oversees their own maintenance, while procurement is still overseen by the

[5] https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

Core Fleet Team. All other departments (and the majority of vehicles and equipment) are procured and maintained by the Core Fleet team.

Figure 1: Current Fleet Breakdown



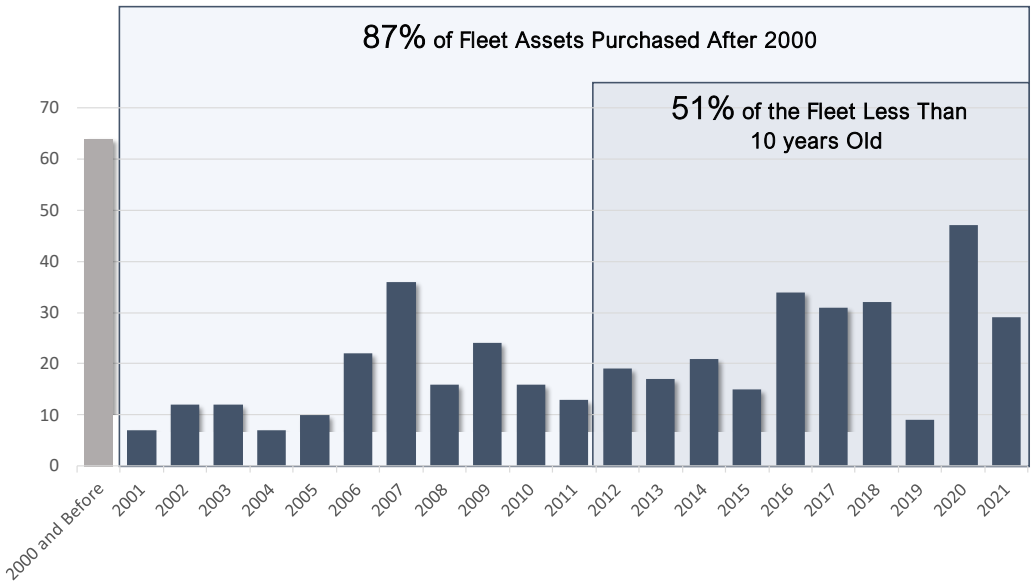
Fleet Age

The Core Fleet Team has a target replacement of seven years for all vehicles, with exceptions made based on utilization. This results in a variety of vehicle ages with some assets as old as 20 years[6]. The vehicle fleet is maintaining an average age of 10 years which is the target moving forwards, particularly as electrification advances and long-term maintenance costs are minimized.

In reviewing average fleet age, it was noted that only 51% of the fleet was less than 10 years old and 13% of the fleet exceeds 20 years of age. This suggests that a significant portion of the fleet is or will be up for replacement or disposal soon - the latter if low utilization and mileage has delayed replacement.

[6] There are other exceptions, like classic Police and Fire vehicles, that are much older and never to be replaced.

Figure 2: Fleet Age



Fleet Utilization

The City's vehicle fleet is generally well utilized across a number of metrics. Even during 2020, when vehicle utilization was expected to decrease due to the COVID-19 pandemic, the average fleet vehicle was used 181.3 days, which is approximately 72% of the year assuming 252 working days per year. The average mileage incurred is approximately 5,500 kilometers per year, or approximately 460 kilometers per month. These numbers are higher for Police vehicles which are not included this analysis.

Utilization targets for municipal fleets are different than those used in logistics or other industries. A municipal utilization target of 80% to 85% is reasonable to account for general availability and vehicle downtime (planned and unplanned). This allows for an opportunity to further optimize municipal fleets by consolidating assets into shared vehicle pools, especially for non-vocational 'A-to-B vehicles'.

A separate study completed for the City suggested a fleet reduction of 10%. Investigating the 10th percentile of utilization shows vehicles that are used less than 100 days or 1500 kilometers each year[7], or that generally travel less than 12 kilometers per day. As is evidenced today, vehicles of this low of utilization are rarely replaced on schedule and often moved into shared vehicle pools. This should continue to be a focus moving forward.

Whether a 10% reduction is feasible, it is recommended that this is determined on a vehicle-by-vehicle basis as they are eligible for replacement, or if a relatively new asset is repeatedly underutilized. The low utilization of assets at the 10th percentile should be considered directional guidance of feasibility only, particularly as the fleet may require some expansion as a result of additional services or employees that require transportation. That said, any vehicle that does not meet the 10th percentile of utilization should not be replaced unless approved by the Core Fleet Team on an exception basis.

[7] This is using 2019 utilization. Reviewing 2020 utilization, this drops to 61 days and 910 kilometers per year.

Opportunity for Electrification

Fleet electrification is central to the Green Fleet Plan as the most sustainable way to transition away from burning fuels for transportation. In a region such as British Columbia, where clean and reliable electricity is standard, shifting to renewable fuels would be a stop-gap measure. There are also environmental and social issues associated with the production and shipping of renewable fuels long distances. Lastly, capital invested in fueling infrastructure for renewable fuels would be better invested in charging infrastructure, much of it permanent City fixtures.

Across the departments engaged through the green fleet planning process, very few vehicles were identified as challenges for electrification. These vehicles typically have higher duty cycles, such as police patrol vehicles, and select vocational vehicles that at times work on multiple shifts during seasonal periods (watering trucks, snow response, etc.). Limitations for fleet electrification are typically related to a lack of dedicated parking for charging infrastructure or a lack of market-ready electric vehicles. These vehicles could be transitioned to renewable fuels in the interim if a suitable supply contract can be sourced.

Fleet Replacement Scenario Analysis

FLEET ELECTRIFICATION APPROACH

One objective of the Green Fleet Plan and the approach to fleet electrification is to establish and adopt corporate policies to guide decision making on vehicle and equipment replacement and purchases. These data driven decisions should be informed through a robust analysis of utilization / usage statistics collected through vehicle telematics.

The ultimate goal of the Green Fleet Plan is to achieve reductions in GHG emissions, with operating and capital savings to help offset the increased cost of an electrified fleet. As per the Corporate Energy and Emissions Management Plan (CEEMP) GHG reduction targets[8], the 2020 vehicle fleet had the following emission:

Table 1 Current Fleet & Equipment Emissions

Fleet Type	Energy (kWh)	Percent (%)	GHG Emissions (tCO_2e)	Percent (%)
Parks Fleet - Facilities Division	53,409	1%	12	1%
Parks Fleet - Parks Division	220,526	2%	52`	2%
Public Works Fleet	4,877,497	50%	1,112	50%
Engineering Fleet	21,685	1%	5	0%
Fire Protection Fleet	512,385	5%	121	5%
Police Fleet	2,181,243	22%	481	22%
Other Fleet	75,184	1%	17	1%
Fleet Subtotal	**7,941,929**	**82%**	**1,800**	**81%**

[8] Corporate Energy and Emissions Management Plan (CEEMP), Stantec Consulting, dated November 3, 2020

Parks Equipment	384,732	4%	91	4%
General Equipment	1,408,523	14%	321	15%
Equipment Subtotal	**1,793,255**	**18%**	**412**	**19%**
Total	9,735,184	100%	2212	100%

If the City were to reduce GHGs by 60% from 2007 levels by 2030 through the vehicle fleet alone, it would need to achieve a reduction of approximately 1150 tCO_2e through electrification, alternative fuels, or other initiatives and policies. Instead, due to considerable carbon reductions in other areas of the CLP (primarily in building retrofits), the target for 2030 fleet vehicle reductions is 706 tCO_2e, including the police fleet.

The Green Fleet Plan achieves this target by transitioning a subset of vehicle replacements between now and the end of 2030[9] to electric vehicles. Due to capital cost premiums associated with battery electric vehicles over traditional internal combustion engine vehicles, the rate and scale of electrification is budget constrained. Similarly, capital investments in charging infrastructure must also be planned.

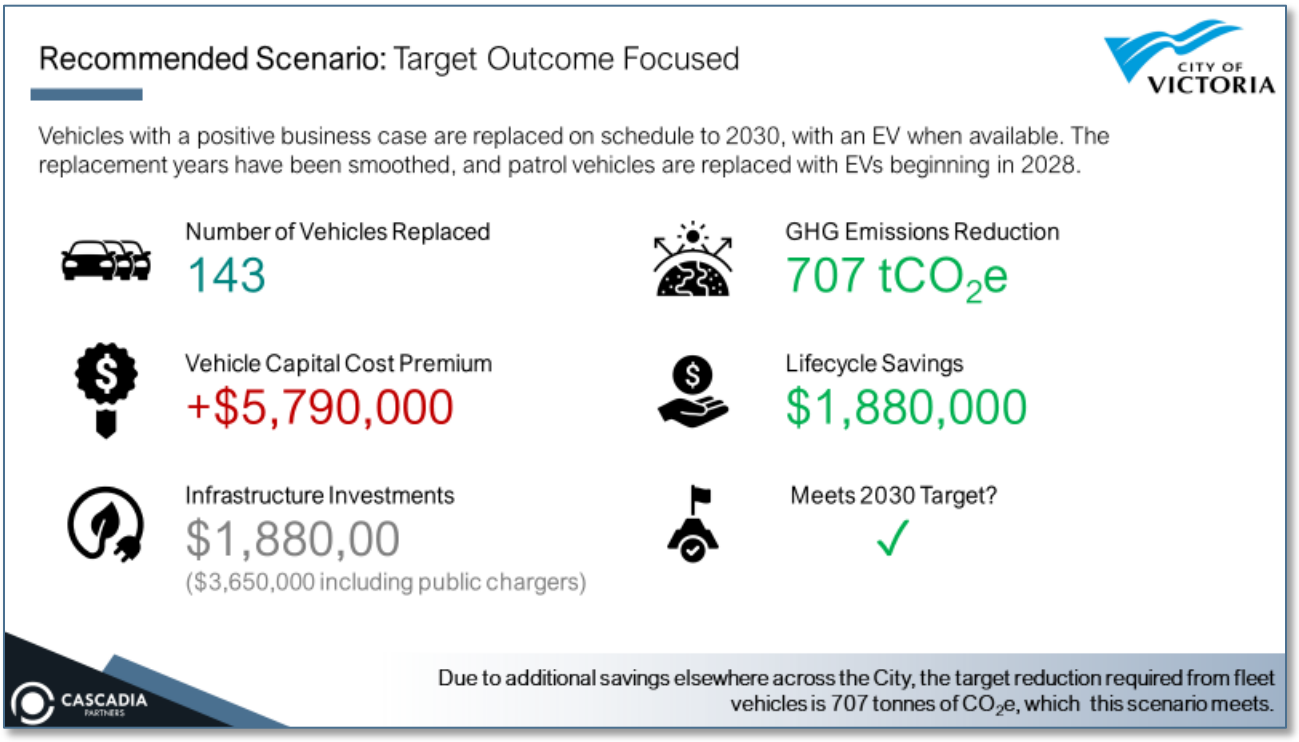
The vehicles prioritized for replacement are those with positive business cases. A breakdown of associated costs and savings is provided in Appendix B, including a sample vehicle from the City's fleet. A positive business case is defined as a vehicle which, due to its level of use, offsets the increased upfront capital cost through fuel, maintenance, and carbon savings. In other words, transitioning these vehicles to electric models will leave the City in a better financial period within one lifecycle.

In order to achieve the target reduction, 143 assets across the core and police fleet will be transitioned to electric vehicles. The replacement schedules were smoothed for infrastructure and capital planning purposes. The total capital cost premium associated with this plan is $5,790,000[10] spread over 9 years but is anticipated to save the City $1,880,000 over the collective lifetime of those assets[11]. Separately, investments of approximately $3,250,000 are required for electrical service upgrades and charging infrastructure, however, these one-time costs will be permanent fixtures of City-owned assets.

This plan to 2030 includes administrative and patrol vehicles in the police fleet, with the latter EVs being adopted beginning in 2028 to provide time for a patrol-rated EV option to become available. This scenario meets 2030 targets and sets the City on the path to meeting 2050 targets.

[9] Vehicle orders will be placed in 2029 for service in 2030, to meet reduction targets by 2030 year end.
[10] This premium is on top of the existing budgeted cost of a traditional replacement.
[11] A detailed example of the operational savings model is included in Appendix B

Figure 3 Recommended Fleet Electrification Scenario



Over the same timeframe, there are nearly the same number of non-EV replacements required for upkeep of the fleet. Some of the non-EV replacements are challenging business cases due to either lower utilization (fire trucks) or limited and expensive electric chassis options (Class 6 / 7 / 8 heavy trucks). As a result, while the count of vehicles being replaced is 143, the total number of replacements is nearly double (including 138 traditionally fueled vehicles). The total spend (EVs and non-EVs) over this timeframe is $41.6 million in spend over 9 years, or an average of $4.6 million[12]/year.

The result is that the capital cost premium associated with meeting our carbon emissions reduction target is approximately 9% of the overall fleet spend forecasted for the same period. This assumes that vehicle replacement timelines are maintained[13].

[12] Years with fire truck replacements are higher, as each unit is estimated to cost $1 million.
[13] There are many examples of 10+ year-old vehicles in the fleet which suggests they are not always replaced on schedule.

Table 2 Fleet Asset Replacements by Year

FACILITY	VEHICLE	2022	2023	2024	2025	2026	2027	2028	2029	2030
DOWNTOWN	Replace with Chevrolet Bolt or similar (or ICE equivalent)	3	1				1			
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)		1	1	3					
	Replace with Ford E-Transit or similar (or ICE equivalent)	2		1						
	Subtotal	**5**	**2**	**2**	**3**		**1**			
FIREHALL 1	Replace with Volvo Rosenbauer (or ICE equivalent)			1		1				
	Replace with Motiv E450 or similar (or ICE equivalent)					1				
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)				2	1			1	
	Replace with Hyundai Kona or similar (or ICE equivalent)					1				
	Subtotal			**1**	**2**	**4**			**1**	
PARKS	Replace with VMC 1200 or similar (or ICE equivalent)	5	4	4				1		
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)	1[14]		1	1	5	8			1
	Subtotal	**6**	**4**	**5**	**1**	**5**	**8**	**1**		**1**
POLICE	Replace with Motiv E450 or similar (or ICE equivalent)									1
	Replace with Chevrolet Bolt or similar (or ICE equivalent)		2	1	1	3				1
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)		3	1	1					
	Replace with Ford E-Transit or similar (or ICE equivalent)		1							
	Replace with Hyundai Kona or similar (or ICE equivalent)		2	1	2	2			1	2
	Subtotal		**8**	**3**	**4**	**5**			**1**	**4**
POLICE PATROL	Replace with Motiv E450 or similar (or ICE equivalent)									4
	Replace with Chevrolet Bolt or similar (or ICE equivalent)							7	3	1
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)							1		
	Replace with Ford E-Transit or similar (or ICE equivalent)					1				
	Replace with Hyundai Kona or similar (or ICE equivalent)							1	4	2
	Subtotal					**1**		**9**	**7**	**7**
PUBLIC WORKS	Replace with BYD 8TT or similar (or ICE equivalent)		1				1	1		
	Replace with VMC 1200 or similar (or ICE equivalent)	4			1		1	1		
	Replace with Motiv E450 or similar (or ICE equivalent)		1							
	Replace with Chevrolet Bolt or similar (or ICE equivalent)	3								
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)	1	2	10	8		2			
	Replace with Ford E-Transit or similar (or ICE equivalent)	2		2	1					
	Subtotal	**10**	**4**	**12**	**10**		**4**	**2**		
CITY OF VICTORIA	**Total**	**21**	**18**	**23**	**20**	**15**	**13**	**12**	**9**	**12**

[14] The F-150 Lightning has considerable pre-orders and may not be delivered in 2022 as anticipated. These orders will be placed but vehicles may not be in service until 2023.

Table 3 Fleet Capital Requirements by Year

FACILITY	VEHICLE	2022	2023	2024	2025	2026	2027	2028	2029	2030
DOWNTOWN	Replace with Chevrolet Bolt or similar (or ICE equivalent)	-$150,000	-$49,000				-$45,476			
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)		-$77,000	-$76,050	-$225,443					
	Replace with Ford E-Transit or similar (or ICE equivalent)	-$156,000		-$76,538						
	Subtotal	**-$306,000**	**-$126,000**	**-$152,588**	**-$225,443**		**-$45,476**			
FIREHALL 1	Replace with Volvo Rosenbauer (or ICE equivalent)			-$1,737,250		-$1,658,056				
	Replace with Motiv E450 or similar (or ICE equivalent)					-$107,161				
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)				-$118,295	-$58,290			-$55,967	
	Replace with Hyundai Kona or similar (or ICE equivalent)					-$58,290				
	Subtotal			**-$1,737,250**	**-$118,295**	**-$1,881,796**			**-$55,967**	
PARKS	Replace with VMC 1200 or similar (or ICE equivalent)	-$183,000		-$170,813				-$341,886		
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)	-$390,000	-$308,000	-$304,200	-$75,148	-$371,451	-$587,805			-$71,268
	Subtotal	**-$573,000**	**-$308,000**	**-$475,013**	**-$75,148**	**-$371,451**	**-$587,805**	**-$341,886**		**-$71,268**
POLICE	Replace with Motiv E450 or similar (or ICE equivalent)									-$123,074
	Replace with Chevrolet Bolt or similar (or ICE equivalent)		-$144,000	-$60,050	-$70,148	-$207,870				-$66,268
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)		-$308,000	-$96,050	-$95,148					
	Replace with Ford E-Transit or similar (or ICE equivalent)		-$84,250							
	Replace with Hyundai Kona or similar (or ICE equivalent)		-$178,000	-$95,050	-$188,295	-$186,580			-$90,967	-$180,537
	Subtotal		**-$714,250**	**-$251,150**	**-$353,590**	**-$394,451**			**-$90,967**	**-$369,879**
POLICE PATROL	Replace with Motiv E450 or similar (or ICE equivalent)									-$492,295
	Replace with Chevrolet Bolt or similar (or ICE equivalent)							-$473,913	-$200,900	-$66,268
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)							-$92,702		
	Replace with Ford E-Transit or similar (or ICE equivalent)					-$82,218				
	Replace with Hyundai Kona or similar (or ICE equivalent)							-$91,702	-$363,867	-$180,537
	Subtotal					**-$82,218**		**-$658,317**	**-$564,767**	**-$739,100**
PUBLIC WORKS	Replace with BYD 8TT or similar (or ICE equivalent)		-$785,000				-$732,134	-$720,528		
	Replace with VMC 1200 or similar (or ICE equivalent)	-$769,000			-$165,172		-$191,723	-$341,886		
	Replace with Motiv E450 or similar (or ICE equivalent)		-$336,000							
	Replace with Chevrolet Bolt or similar (or ICE equivalent)	-$134,000								
	Replace with Ford F-150 Lightning or similar (or ICE equivalent)	-$78,000	-$154,000	-$760,500	-$601,180		-$146,951			
	Replace with Ford E-Transit or similar (or ICE equivalent)	-$156,000		-$153,075	-$75,861					
	Subtotal	**-$1,137,000**	**-$1,275,000**	**-$913,575**	**-$842,213**		**-$1,070,808**	**-$1,062,414**		
CITY OF VICTORIA	**Total**	**-$2,016,000**	**-$2,423,250**	**-$3,529,575**	**-$1,614,688**	**-$2,729,915**	**-$1,704,089**	**-$2,062,617**	**-$711,701**	**-$1,180,247**

GREENHOUSE GAS EMISSION REDUCTIONS

Electrifying the fleet following the above replacement schedule will yield a reduction of 707 tCO_2e by the end of 2030. Illustrated below is a graphical representation of remaining fleet emissions on a year-by-year basis, including the provincial low carbon fuel standard which is forecasted to reduce carbon intensity of traditional fuels by 12% before 2030.

Figure 4: GHG Reduction Forecast

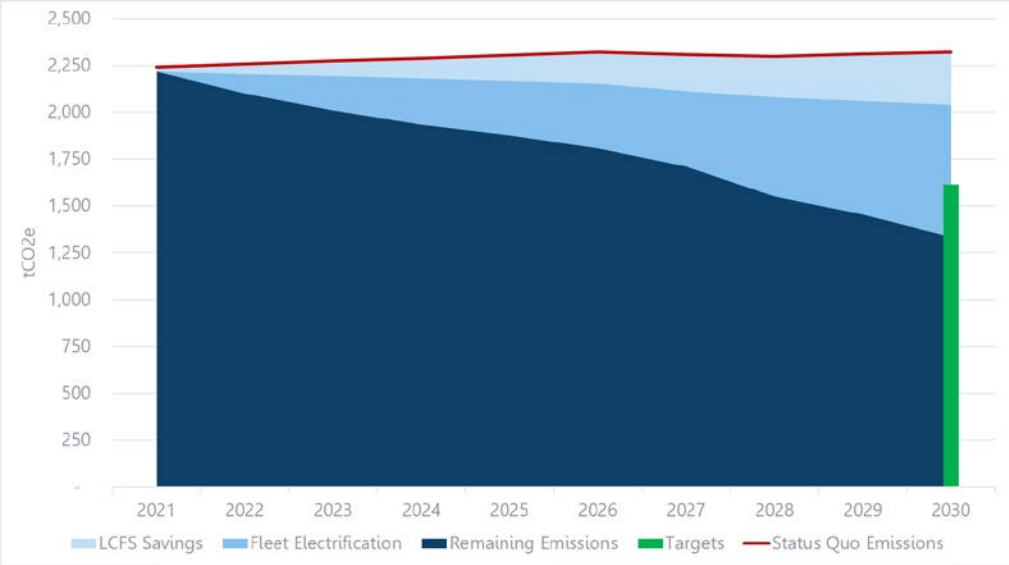


Table 4 GHG Emissions Reduction Schedule

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Status Quo Emissions (CEEMP)	2,242	2,257	2,273	2,289	2,305	2,321	2,307	2,299	2,311	2,319
Less: LCFS	2,215	2,203	2,191	2,179	2,167	2,154	2,113	2,078	2,061	2,041
Total Savings from Electrification	-	95	168	266	319	378	450	570	611	707
Remaining Emissions	2,215	2,108	2,023	1,913	1,848	1,775	1,663	1,508	1,451	1,333
Fleet Emissions Reductions Goal										706

Not depicted in this graph is the opportunity to leverage renewable diesel or ethanol-blends for remaining traditionally powered fleet vehicles. This can be an effective strategy for high-use vehicles or equipment that do not have market-ready electric alternatives (e.g. medium- and heavy-duty trucks). It is important to note that Figure 4: GHG Reduction Forecast shows the City exceeding the GHG reduction target. This is to account for the low carbon fuel standard in event the province is unable to achieve lower carbon fuel supplies.

Capital Investment Strategy

Investments in fleet electrification are two-pronged: the capital cost premium associated with higher vehicle acquisition costs, and the investments in the required charging infrastructure to keep them fully charged for operations.

PREFERRED FLEET CAPITAL INVESTMENT STRATEGY

Vehicle electrification criteria were established to quantify the operational savings (by vehicle) associated with a transition away from fossil fuels. The result of applying these criteria across the fleet is a prioritization of assets for replacement based on the associated long-term savings of switching to BEV. It should be noted that there are a few important components, assumptions, and exceptions to this strategy:

1. Capital Limitations: There are more positive business cases than there is available capital. As mentioned before, there are replacements of vehicles with traditional fuels that, if additional budget were available, could be transitioned to electric to accelerate GHG emission savings. Should additional budget be available, the EV lifecycle model can be updated to identify the primary candidates based on fuel consumption and asset age. A ranked list is available in Appendix C, current as of writing.
2. Vehicle Sequencing: A sequence of vehicle replacements is proposed based on the information and data made available. Operational needs will necessitate alternative or additional replacements. This plan should be reviewed against the replacements requested each year and adjusted accordingly with the goal of offsetting fuel consumption, not of purchasing a target number of EVs.
3. Vehicle Generation: Fleet managers vary in position with regards to adopting the first model year of a new vehicle or new vehicle generation. The City expressed that new vehicles and new generations are often adopted immediately. For this reason, we have included e-Transits and F-150 Lightnings starting as early as 2022 in the Green Fleet Plan. If these vehicles are backordered or not available, the replacements should be delayed.
4. Patrol Vehicles: Including VicPD vehicles is necessary to meet both 2030 and 2050 targets due to their high utilization. While the police department is prepared to replace administrative vehicles with EVs, there are no current offerings for patrol ready alternatives. We are confident that an alternative will be available by 2028[15] and expect to see many other police fleets transitioning around this time. For this reason, patrol vehicle electrification has been slated to begin in 2028.

As EV technology improves and matures, electric vehicles will be priced similarly or on par with their internal combustion engine vehicle equivalent. The result will be the removal of the capital cost premium associated with battery electric vehicles. The other investment required to support fleet electrification is that of charging infrastructure, which will be permanent fixtures in City assets.

The long-term capital plan should be adopted to guide investment in fleet electrification through the annual budget process at a level consistent with meeting the Climate Leadership Plan corporate fleet emissions reduction target.

Leasing as an Alternative

The Green Fleet Plan, and the capital plan that underpins it, is based on vehicle purchases, which is the primary vehicle acquisition method for the fleet[16]. There is an opportunity to lease vehicles and commit for shorter lifecycles of 3 years. This has financial implications to capital and operational budgeting processes which would need to be reviewed by finance and fleet departments in more detail.

The benefit to leasing vehicles is the opportunity to adopt the latest technology in a rapidly evolving sector that sees considerable advancements in battery technology, electric vehicle range, and available alternatives across the vehicle classes. With standardized charging infrastructure (J-1772 for level 2, CCS for DC fast

[15] Ford executives have already stated on record the Explorer (base of Utility Interceptor) is slated for electrification
[16] Some unmarked police vehicles and other assets are leased, but this is an exception to the approach of purchasing

charging), leasing a variety of makes and models is possible without having to make manufacturer specific infrastructure investments.

ELECTRIC VEHICLE CHARGING INFRASTRUCTURE INVESTMENT STRATEGY

This section summarizes considerations for providing EV charging infrastructure for the growing number of EVs in the City's fleet, as well as provision of public EV charging at City facilities called for in the City's Electric Vehicle and E-Mobility Strategy. Key strategies include:

1. **Plan wholistically for EV fleet, public, employee, and other EV charging uses:** When planning EV charging infrastructure at facilities, it is important to consider the different types of EV charging applications that may occur at a site – e.g., fleet charging, public charging, employee charging, etc. Likewise, facility electrification plans should be considered. This wholistic planning helps ensure optimal electrical infrastructure renovations and avoids the potential for stranded assets.

2. **Sequence infrastructure:** Installation of EV charging infrastructure should be carefully planned and sequenced at each facility. Tranches of parking spaces can be made "EV Ready" (i.e. featuring an adjacent electrical outlet) during electrical renovations, accommodating the next few years of expansion of the EV fleet. EV chargers can be installed each year at EV Ready spaces, as fleet vehicles are procured, demand for public charging expands, etc.

3. **Customize EV charging infrastructure designs based on charging performance requirements for each use case:** "Charging performance" refers to reasonable minimum amounts of electrical energy that EV charging infrastructure will be able to deliver to vehicles to meet their daily needs. Amongst other factors, appropriate charging performance is dictated by the type of vehicles being charged (i.e. is it a small vehicle that uses little power? Or a large truck that uses much more power?); the amount of time vehicles have to charge (e.g. 12 hours overnight vs. 2-hours during a shift break); and the maximum distance vehicles travel in a day. Charging performance essentially determines the maximum amount of EV "load sharing" (the sharing of the capacity of an electrical circuit between vehicles, using EV energy management systems) that is viable for a particular parking area. In turn, judicious use of load sharing can reduce the overall cost of both capital and ongoing operating expenses, while still providing for the needs of EV users.[17]

These strategic considerations informed the EV Infrastructure Expansion Plan for City facilities (described below). For each City facility at which fleet vehicles are parked, a conceptual design was developed and high-level indicative costs determined. This conceptual design provided for fleet charging, as well as provisions for public charging in parkades. The cost estimates are intended to inform the City's capital budgeting for future years. It is anticipated that for each facility, the City will conduct further detailed electrical design, refining the preliminary design concepts developed as part of this *Green Fleet Plan* for capital budgeting purposes.

[17] Optimal designs will use load sharing to meet vehicles' charging needs, while minimizing charging infrastructure's electrical demand, and the associated capital and operating costs these can entail - Minimizing electrical demand allows for more chargers to be accommodated on existing electrical infrastructure (e.g. an existing electrical utility service, distribution feeder, panel, etc.), thereby minimizing the costs of EV charging infrastructure. Minimizing demand decreases peak EV loads relative to unmanaged charging, thereby reducing electrical utility bill costs.

ELECTRICAL VEHICLE INFRASTRUCTURE EXPANSION PLAN 2022 - 2027

The EV infrastructure expansion plan was developed via the following steps:

1. **Determine fleet, public charging, and other needs:** Fleet charging infrastructure needs were determined according to when fleet vehicles parked at City facilities are electrified. The public charging demand at each city-owned parkade was determined based on the *City of Victoria Electric Vehicle Strategy*.

   Provisions for employee charging, CRD vehicle charging, and other EV charging uses at City facilities were not part of this analysis but can be considered during detailed design.

2. **Determine charging performance:** To determine appropriate charging performance for fleet vehicles, the electrical energy required for daily charging (kWh/day) was determined for each vehicle. It was assumed vehicle use was consistent throughout the year, that fleet vehicles charge for 12 hours per day, and are used 250 days a year. The exception to this is shorter charging times and higher levels of use were assumed for police and fire vehicles. Finally, an additional 50% safety factor was included, in case fleet vehicles are used more intensively in the future. Viable levels of load sharing were then determined for fleet vehicles.

   Appropriate charging infrastructure for public charging was deemed to be a maximum of 4-share on 40A circuits. It is important to note that higher levels of sharing may be sufficient to meet drivers needs in the City parkades – up to 8-share on 40A circuits may be sufficient to meet the needs of commuters in Victoria. However, the City has outlined that the purpose of the public chargers is to incentivize public EV adoption, who may desire faster charging times. With that consideration, 4-share on 40A circuits was adopted across public charging infrastructure – conservatively, this would add an average of 62 km of range over an 8-hour charging period, more than adequately providing for daily commutes.

   During detailed design, higher levels of load sharing could be considered. Likewise, alternate configurations that provide similar charging performance to 4-share on 40A circuits (e.g. 10-share on 80A circuits) can be considered to optimize costs.

   Based on 4-share charging and available infrastructure the following plan was created for public charging at city-owned parkades:

Table 5 Public Charger Rollout Plan

Public Charger Rollout Plan							
Year	Existing	2022	2023	2024	2025	2026	2027
View	4	36	68	0	0	0	0
Centennial	2	56	68	0	0	0	0
Bastion	2	0	0	0	0	68	56
Johnson[18]	2	0	0	68	96	0	0

3. **Electrical demand analysis:** The historical maximum demand of each site was determined from BC Hydro data. The demand data revealed the building power available for charging EVs while leaving

[18] This aligns with plans to upgrade the electrical service at Johnson in 2023.

20% room for future expansion and building electrification. The power available at each site was then compared with the additional power needed for EVs based on the charging performance analysis to determined necessary electrical infrastructure upgrades.

Conceptual design of EV charging infrastructure at City facilities: For each site, the infrastructure upgrades were planned based on years that EVs are projected to be added to the fleet. The infrastructure plan for each site took into consideration site layout, charging speed, and upgrades to the facilities planned by the City. The electrical upgrades that determined the infrastructure investment strategy for each site can be found on the single line diagrams in Annex 2. Upgrades were sequenced into phases, providing for progressive tranches of EV adoption in the fleet, as well as growing provision of public charging.

4. Indicative costing: Based on the conceptual electrical designs for each facility, indicative cost estimates were developed. Costing analysis for each site can be found in Annex 3.

   The table below illustrates projected EV charging infrastructure and EV charger (EVSE) costs at each facility. Further details on designs are noted in Annex 3.

Table 6 Charging Infrastructure Investments

FACILITY	LINE ITEM		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
VIEW STREET PARKADE	PHASE 1	FLEET																	
		PUBLIC	$41,387																
	PHASE 2	FLEET																	
		PUBLIC		$60,935															
	EVSE COST	FLEET																	
		PUBLIC	$72,000	$136,000															
	SUBTOTAL		$113,387	$196,935															
	FLEET EVSE #																		
	PUBLIC EVSE #		36	68															
BASTION SQUARE PARKADE	PHASE 1	FLEET																	
		PUBLIC					$156,761												
	PHASE 2	FLEET																	
		PUBLIC						$61,993											
	EVSE COST	FLEET																	
		PUBLIC					$136,000	$112,000											
	SUBTOTAL						$292,761	$173,993											
	FLEET EVSE #																		
	PUBLIC EVSE #						68	56											
CENTENNIAL SQUARE PARKADE	PHASE 1	FLEET	$17,190																
		PUBLIC	$63,028																
	PHASE 2	FLEET																	
		PUBLIC		$80,823															
	EVSE COST	FLEET	$24,000																
		PUBLIC	$112,000	$136,000															
	SUBTOTAL		$216,218	$216,823															
	FLEET EVSE #		12																
	PUBLIC EVSE #		56	68															
JOHNSON STREET PARKADE	PHASE 1	FLEET																	
		PUBLIC			$171,016														
	PHASE 2	FLEET				$9,167													
		PUBLIC				$100,840													
	EVSE COST	FLEET				$16,000													
		PUBLIC			$136,000	$192,000													
	SUBTOTAL				$307,016	$318,007													
	FLEET EVSE #					8													
	PUBLIC EVSE #				68	96													
PUBLIC WORKS	PHASE 1			$244,599															
	PHASE 2							$48,310											

FACILITY	LINE ITEM	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
	EVSE COST		$36,000	$32,000	$32,000	$53,625	$22,000			$12,000			$20,000					
	SUBTOTAL		$280,599	$32,000	$32,000	$53,625	$70,310			$12,000			$20,000					
	FLEET EVSE #		18	16	16	13	11			6			10					
VICTORIA POLICE DEPARTMENT	PHASE 1		$226,957															
	PHASE 2					$ 88,706												
	EVSE COST		$16,000	$6,000	$8,000	$12,000		$18,000	$16,000	$22,000	$14,000		$19,500	$9,500	$3,500		$2,000	
	SUBTOTAL		$242,957	$6,000	$8,000	$100,706		$18,000	$16,000	$22,000	$14,000		$19,500	$9,500	$3,500		$2,000	
	FLEET EVSE #		8	3	4	6		9	8	11	4		6	4	1		1	
FIREHALL 1	PHASE 1					$16,097												
	PHASE 2											$55,592						
	EVSE COST		$2,250			$4,500	$6,750					$4,500	$2,250		$2,250			
	SUBTOTAL		$2,250			$ 20,597	$6,750					$60,092	$2,250		$2,250			
	FLEET EVSE #		1			2	3					2	1		1			
PARKS (BEACON HILL)	PHASE 1		$146,338															
	PHASE 2							$360,810										
	PHASE 3														$31,398			
	PHASE 4																	$21,529
	EVSE COST		$24,750	$16,500	$16,500	$16,500	$24,750	$33,000	$4,125				$28,875	$20,625	$8,250		$4,125	
	SUBTOTAL		$171,088	$16,500	$16,500	$16,500	$24,750	$393,810	$4,125				$28,875	$20,625	$39,648		$4,125	$21,529
	FLEET EVSE #		6	4	4	4	6	8	1				7	5	2		1	3
CITY OF VICTORIA	TOTAL	$329,605	$1,110,652	$361,516	$374,507	$484,190	$275,803	$411,810	$20,125	$34,000	$14,000	$60,092	$70,625	$30,125	$45,398	$0	$6,125	$21,529
	PUBLIC TOTAL	$288,415	$413,758	$307,016	$292,840	$292,761	$173,993	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	FLEET TOTAL	$41,190	$696,894	$54,500	$81,667	$191,428	$101,810	$411,810	$20,125	$34,000	$14,000	$60,092	$70,625	$30,125	$45,398	$0	$6,125	$21,529

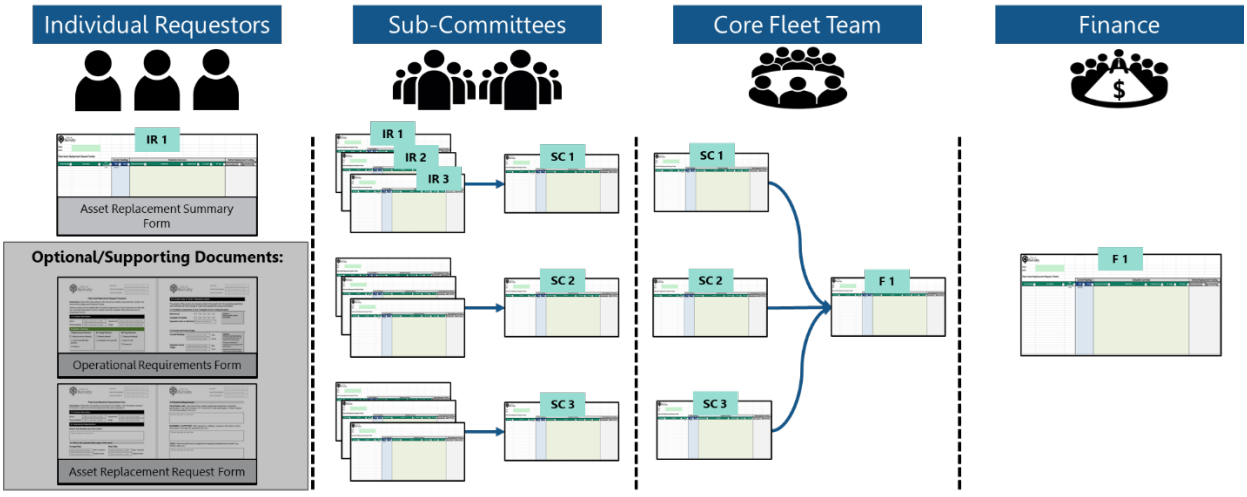
Fleet Management Processes

VEHICLE REPLACEMENT PROCESS & LIFECYCLE

To support implementing the above vehicle procurement strategy considerations, a revised replacement process and policy should be considered. A more detailed documentation of this process is available in Appendix E, which takes the form of a draft policy document. The process is as follows:

1. Individual Requestors submit one *Asset Replacement Summary Form* with all vehicle requests. Each vehicle requires one line in the form. Requestors may refer to the *Operational Requirements Form* and the *Asset Replacement Request Form* for additional support. The core fleet team should provide corporate training for fleet policy and procurement for managers and relevant staff.
2. Sub-committees receive the *Asset Replacement Summary Forms* from the individual requestors. The sub-committees compile all the forms into one *Asset Replacement Summary Form* per department to be presented to Finance.
3. Core Fleet receives the *Asset Replacement Summary Forms* from all the sub-committees and compiles it into one summary form. Core Fleet will request additional information from the sub-committees if needed and then evaluate and draft an annual fleet budget for approval by relevant department heads.
4. Finance receives an annual fleet budget based on the *Asset Replacement Summary Form* with all assets, from the Core Fleet Team.

Figure 5 Proposed Asset Replacement Approach



The proposed policy is an example created previously for others who have seen considerable success in both reducing their fleet (especially the use of "spares"), increasing shared vehicle usage, and right-sizing the remaining vehicles to minimum size and power required with replacement asset electrification as standard.

As a gatekeeper to this policy, lifecycle policy considerations are needed. The EV business case model includes a 10% lifecycle extension for all vehicles transitioned to electric. There should be consideration of extending the base replacement timeline of new vehicles, regardless of fuel type, based on increased efficiencies and reliability associated with today's vehicles.

VEHICLE PROCUREMENT STRATEGY CONSIDERATIONS

Electric Drivetrain First

With a few notable exceptions (police patrol, specialty vehicles, vehicles with limited to no downtime), every replacement vehicle should first consider electrification if there is budget available and it meets operational requirements. When reviewing operational requirements, the needs of the end user should be re-evaluated with right-sizing the fleet in mind. There are likely to be vehicles throughout the City whose use requirements have changed since originally acquired and the vehicle type has not been updated accordingly.

Vehicles identified for electrification should be replaced by EVs following the proposed schedule. Vehicles for non-EV replacement should still consider electrification when it is a positive business case by delaying other replacements (where possible) or delaying the replacement of that unit until additional capital is available. If more rapid progress on reducing fleet corporate GHG emissions is desired, the additional vehicles with a positive business case for electrification can be found in Appendix C.

Our recommendation is that procurement of replacement vehicles must be electric for all commercially available classes. Alternatives should only be considered when operational requirements justify traditional fuel or lifecycle costs create a considerable negative business case.

Vehicle Right-Sizing

Existing fleet assets are typically replaced in a like-for-like fashion by departments, even as services and operational requirements change over time. While operational needs often generate vehicle upsizing, rarely do departments identify opportunities to downsize the asset to a more efficient solution. One example that was identified during our workshops was a larger van / box truck that was previously used for drafting and blueprints; now that everything has gone online, there would be no remaining reason its replacement vehicle could not be a small electric vehicle, or even a shared vehicle.

Utilization Tracking & Targets

To determine whether a 10% reduction target of Core Fleet vehicles (provided by previous analysis) was feasible, fleet utilization at the tenth percentile was completed across annual mileage, days used annually, and average kilometers per day used[19]. This was compared across 2019 and 2020 to account for differences as a result of the pandemic.

Table 7 Low Utilization Metrics

Utilization Metric	2019	2020
Annual Kilometers Traveled	1537 kms	911 kms
Number of Days Used	99 days	61 days
Average Kilometers per Day	12 kms/day	11 kms/day

The above utilization metrics suggest that rationalizing or consolidating these vehicles into shared vehicles is feasible.

The vehicles that are likely candidates for this include a 15-year-old Ford Focus (used 51 days in 2019), a 20-year-old Chevrolet Cavalier (driven 896 kilometers in 2019), and a 15-year-old Smart ForTwo (used 18 days

[19] Note: Some data challenges exist where some assets were not reporting through the telematics solution.

and driven 132 kilometers in 2019), along with a collection of 20+ year old pickup trucks used across the City.

Utilization analysis should also be completed periodically to review which departments use the most fuel or have vehicles with the greatest potential benefits from fleet electrification. This could help to reprioritize departments vehicle requirements and improve outcomes with more efficient capital utilization.

The Core Fleet Team should undertake a review of the utilization of vehicles set for replacement each year to determine what can be rationalized or consolidated into a shared vehicle pool. Similarly, when vehicles require significant maintenance or repair, this analysis should be completed to consider disposal as well.

Based on our analysis, we have identified 25 candidates for removal from the fleet. These vehicles are listed in Appendix D – Low Utilization Assets for review with departments to confirm the utilization metrics are correct[20]. If the vehicles are found to be underutilized, they should be disposed of and replaced by access to pool vehicles or car share vehicles as needed.

We recommend that the above utilization analysis is completed annually to target vehicles for disposal / reassignment and replacement with pooled or car share vehicles until a 10% reduction in fleet assets is achieved.

Vehicle Standardization

A formalized policy with the intention of standardizing vehicles where possible will aid in reallocating assets across departments or uses as necessary. In reviewing the current fleet, there is a mix of makes and models by vehicle class that is likely driven by department or end user preferences. For example, light duty half-ton pickup trucks include the Ford F-Series (including Super Duty), the Dodge Ram (including heavy-duty), and the Chevrolet Silverado (including heavy-duty) / GMC Sierra (including heavy-duty). In the midsize truck category, there is the GMC Sonoma / Chevrolet S10 and the Ford Ranger. This mix persists through other vehicle classes and types as well.

While these vehicles can be largely interchangeable within their own vehicle class for reallocation, it can create anomalies within department fleets. More importantly at the Core Fleet level, this necessitates increased parts stock, reduces economies of scale in vehicle purchasing, requires knowledge of multiple makes and models for outfitting procedures, and can include varying maintenance schedules. An emerging best practice in use by the Core Fleet is repeat purchasing contracts to support fleet vehicle make and model consistency. Use of these contracts must follow legislated procurement guidelines. Formalizing this current procurement practice will support fleet standardization.

Vehicle & Technology Pilots

The Fire Department is currently pursuing a pilot with a fully electric fire engine, complete with EV infrastructure upgrades and potentially a wireless charging pad / bay in the new fire hall. This is being supported partially by the Province, which offers funding through the Specialty Use Vehicle Incentives (SUVI) Program. Specifically for medium and heavy-duty vehicles, there is an opportunity for the City to explore other applications partnering with Class 6 truck manufacturers.

Implementing a pilot program, even without financial grant assistance, provides a number of benefits including realizing earlier GHG reductions, reducing risk, optimizing fleet investments, and building expertise in the area. The partnerships that are created can prove to be beneficial in the future through priority access

[20] Errors in the telematics system or human error in recording mileage could necessitate retaining the asset.

to new technology or product waitlists but require efforts in being a “first mover” in the space. Some challenges are also associated with pilots, such as when technology does not meet operational needs, and sometimes the excess costs are not fully covered by grant funding or may not be eligible at all. Lastly, another challenge with road legal vehicles is a delay for Transport Canada approval, so non-roadgoing equipment applications may be preferred.

GENERAL OBSERVATIONS

Telematics Solution

An existing system from Vecima Networks is in place for fleet reporting. Data is available for basic functions such as mileage, idle time, and location tracking on all units, as well as fuel usage on a subset of units.

The primary challenge lies in the implementation of the solution, which was paused after Phase 1. As a result, the primary outfitting and solution configuration was completed, but Phase 2 capabilities for advanced reporting and functionality was not completed. Advanced features include ancillary equipment reporting (i.e., counting garbage packer compaction rates, snow clearing equipment usage, etc.). Reengaging the implementation team to complete these configurations would benefit fleet planning and optimization.

Core Fleet Resourcing

The Core Fleet Team is currently lacking a dedicated Fleet Analyst or Fleet Planner who would own all fleet-related analysis and data centrally and would develop corporate fleet policy. Without this resource, the core fleet team cannot regularly analyze vehicle utilization, identify fleet reduction / shared vehicle opportunities, and implement fleet electrification initiatives. This resource would further support the Core Fleet Team in asks such as GHG reporting or capital planning for future fleet purchases. Outside of the Core Fleet Team, the analyst would work with other departments (Engineering, Parks, etc.) when they have specific analysis or ongoing reporting needs. Lastly, they would be responsible for the telematics solution, including working with the vendor on enhancements and in maintaining connectivity of the existing beacons / fleets.

Vehicle Sharing

The City has a limited shared vehicle pool located at City Hall. In reviewing fleet utilization, there is a pool of non-vocational vehicles with limited use. In the interest of rationalizing the fleet and achieving a 10% reduction in size, non-vocational vehicles that do not meet utilization targets should be consolidated into a shared vehicle pool wherever feasible and possible. In addition to reducing fleet operating costs and capital outlays, this creates space for future fleet growth and provides an opportunity to optimize vehicle placement for EV charging infrastructure.

An option for further consideration to retain flexibility in fleet requirements for “A to B” vehicles is partnering with a car share program such as Modo. This has a low fixed cost and could be used as a relief mechanism when reducing the overall fleet without impacting end users who require access to a vehicle. The scale of this opportunity is relatively small (between 5% and 10% of the fleet, depending on usage). While there is opportunity to optimize the fleet in this manner, this should be considered after other core initiatives are in place, particularly given the change management requirements resulting from shifting staff to shared vehicles.

Alternative Transportation

There is existing usage of bicycles and other active transport used throughout the City, including in the Victoria Police Department. Expanding the use of other transportation, particularly during fair weather, can reduce fleet needs and allow for further vehicle sharing as described above. Expanding to different modes, particularly as electric scooters and electric bicycles as legal frameworks are put in place provincially, can

provide opportunities to reduce vehicle trips. While public transit is an option to include in this category, it generally faces significant pushback from those accustomed to having assigned fleet vehicles.

At time of vehicle replacement or rental, the Core Fleet Team should discuss alternative transportation options with staff. The expansion of transportation alternatives should be promoted across the City to support efficient use of the vehicle fleet, staff wellness, and to encourage staff to consider the role of alternative means of transportation in their personal transportation choices.

Implementing public transit is easiest among existing users. A staff survey of commuting choices to and from work may identify those who rely on transit every day. Incentive programs (e.g., paying for staff transit passes) could extend that use to replace fleet vehicle trips, but may come at the cost of productivity[21]. Public transit alternatives should be made available to those who want to take advantage of them - particularly where there are opportunities to leverage direct, high-speed routes - but transit alternatives not proposed as a core tenet of the Green Fleet Plan.

Renewable Fuels

During the transition to an electrified fleet, there will still be considerable fossil fuel consumption. As part of the provincial buying group, the City of Victoria can access renewable fuels to reduce the carbon intensity and GHG emissions associated with the operation of these vehicles.

Without a City-owned fueling station, it will be difficult to source renewable fuels for the fleet. Given that current City fueling stations are being decommissioned until a later date, the delivery and provision of renewable fuels will have to be outsourced. Renewable fuel pricing is becoming more competitive and can be an efficient way to reduce total GHG emissions. The Green Fleet Plan as written does not assume any renewable fuel purchases, so any renewable fuels can be used to offset shortcomings in fleet electrification or other emission reduction initiatives. The premiums associated with renewable fuels are outweighed by meeting or exceeding emissions targets as quickly as possible. As climate change accelerates and organizations stretch to do all that they can, renewable fuels should be leveraged wherever possible to reduce the City's GHG emissions.

Anti-Idle Devices and Reporting

Where possible, installing anti-idle devices or reminding drivers through in-vehicle alerts to reduce idling should be considered. If alerts or devices are not used, reporting and tracking idling should be completed to identify vehicles with high-idle factors. These vehicles are often prime candidates for electrification, even if they require specialized outfitting, because of the fuel savings associated with a reduction in daily idle time of a few hours per unit.

Furthermore, departments with vehicles that are excessively idling against City policy and bylaws can be notified. If the trends do not reverse, policies could be developed to charge BUs for excessive idling, with funds going to the Environmental Reserve Fund as per bylaw 07-069[22].

Standardize Charging Infrastructure

There are benefits in standardizing charging equipment including having a single service contact, consistent warranties, increased buying power, a single platform for reporting / data analysis, and effective load-balancing across the system. All chargers installed should be connected smart chargers, to allow for usage

[21] Transit routes are not on demand, often not as direct, nor as time efficient as driving. Opportunities for staff to work while travelling by bus are limited.
[22] https://www.victoria.ca/assets/City~Hall/Bylaws/bylaw-07-069.pdf

data, load balancing, and service interruption alerts. Using multiple providers creates challenges in each of these areas that results in more downtime, increased spares inventory, less knowledge sharing, and reduced buy-in from users.

The City intends to contract out the majority of the installations with an in-house team maintaining, and operating charging stations as part of facilities management. As the demand for charging increases, the facilities team may struggle in finding and retaining the required electricians. By standardizing equipment where possible, outsourcing this work is easier to accomplish.

Performance Management Plan

Replacing existing fleet assets with electric vehicles and equipment only achieves the intended outcomes when they are deployed to the same extent that the asset they replace was used. As identified in utilization analysis, some units are underutilized in each department, likely due to end-user preference. For that reason, a robust benefits measurement reporting process must be in place.

Each electric vehicle procured for the fleet should have usage-based targets based on the asset it replaced. These targets should be determined during procurement and baselined accordingly. Each year, the utilization of the asset should be compared against the baseline to confirm that carbon and operational savings are being achieved.

To ensure transparency and create accountability, consideration should be given to implementing an annual fleet carbon counter policy or bylaw. This can be further used to prioritize investments in transitioning the fleet away from traditional fossil fuels when carbon reduction targets are not being met.

Unless targets are revised, progress should be measured against those targets listed in Table 4 GHG Emissions Reduction Schedule annually. These targets should be a key performance indicator for fleet managers and fleet users, with action plans put in place when targets are missed.

USAGE MEASURES

There are four usage metrics that are helpful for fleet decision making and annual performance management / benefits tracking of individual units within the fleet.

1. Days Used: An annual count of days where a vehicle moved at least once a day[23]. This metric is helpful in identifying vehicles that are prime candidates for sharing programs. Some assets, such as winter operations, will have sufficient mileage from snow clearing activities but could be repurposed elsewhere in the City in the offseason.
2. Average Kilometers per Day Used: Building on the above, identifying the average kilometers traveled per day that a vehicle is used will aid in shared vehicle decisions. If a vehicle is used 150 days each year, but the daily average mileage is 3 kilometers, there are alternative modes of transportation to be considered, including shared vehicle models.
3. Annual Fuel Usage: When available through the telematics solution or other asset-based fuel tracking solutions, this is the primary savings driver. For GHG emissions reduction reporting, the volume of fuel consumed by a replacement vehicle should be tracked based on the asset it replaced (using the higher of two previous full years). For operational cost savings, the annual cost of fuel for the replacement vehicle should be compared against the fuel cost of the vehicle it replaced and should

[23] A minimum travel distance should be defined to remove trips within the works yard, shop, etc.

be tracked as contribution towards the capital repayment of that asset. If telematics or similar data is not available, the fleet team has two other proxies for measuring savings:

a. **Annual Mileage:** Applied to assigned and shared vehicles, tracking of annual mileage in electric vehicles can proxy fuel and GHG emissions savings based on the asset(s) it replaced. The baseline should be the higher of the annual mileage for the vehicle it replaced in the two final full years of service.
b. **Annual Hours:** For vehicles with a high idle factor[24] or equipment that does not have a traditional odometer, tracking of annual hours is preferred to mileage. With a considerable amount of emissions related to necessary vehicle idling, there is a material benefit to electrification. The baseline should be the higher of the annual usage for the vehicle it replaced in the two final full years of service.

While the above metrics provide insight to the benefits and savings of electrifying a particular vehicle, this does not accurately reflect overall emissions at the department or the City. For that reason, we propose developing an emissions plan or carbon budget for each department which can be tracked and reported against. Using the baseline GHG emissions by department as provided in the CEEMP, the City can compare actual emissions each year by calculating the carbon footprint through annual fuel usage per department (including electricity used for charging vehicles). Each department should have a decreasing forecast based on the electric vehicles that are scheduled to come online and any use of renewable fuels. If reductions in fuel use are not being achieved from EVs because of underutilization, an analysis of the cause should be undertaken.

UNDERPERFORMING REPLACEMENTS

It is possible that once replaced with an electric alternative, an asset is not used to the same extent as the vehicle it replaced due to user preference or a lack of familiarity with electric vehicles. This is detrimental to the overall Green Fleet Plan because emission savings are not being achieved (assuming they are using an older internal combustion engine unit instead) and because valuable capital is tied up in an under-utilized fleet asset. To improve the likelihood of adoption, driver training for all fleet users should be a core component of this strategy.

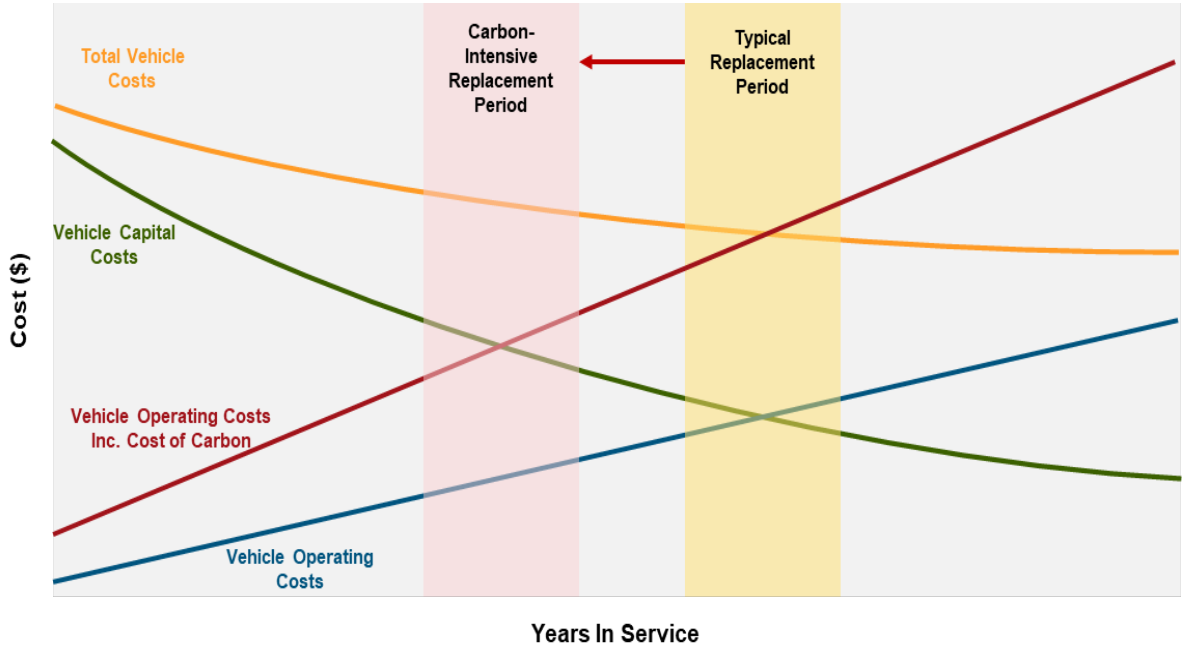
When an EV is not being used by a department, the Core Fleet Team should investigate. If there are challenges in charging, or users are not familiar with EVs, the Core Fleet Team should rectify any issues and / or provide the necessary training. If a vehicle is not meeting operational needs, it should be redeployed to another department and an application to replace the vehicle with a traditional internal combustion engine equivalent completed[25].

If the vehicle meets operational requirements and a department still refuses to adopt the EV, the vehicle should be reassigned to another department and not replaced. A vehicle with low utilization from user preference in a department that is meeting their needs with existing older vehicles is therefore not required by this department and is an opportunity for fleet rationalization / consolidation. As with all requests to expand the fleet, any attempt by the department to subsequently replace this unit will follow vehicle rightsizing and the EV-first procurement policies.

[24] High idle factor vehicles are those that idle for 4 or more hours each day (light trucks, bucket trucks, etc.)
[25] While consideration is owed, the use of traditional fuels must be warranted and proven through operational requirements

LIFECYCLE MANAGEMENT & CARBON REDUCTION

In managing the City fleet, it is important to consider aging assets as they often have outsized impacts on operating costs and emissions. As vehicles age, their capital costs decrease while operating costs (maintenance, fuel usage, etc.) increase. When incorporating the non-cash cost of carbon into the latter, operating costs increase quickly. In comparing the V8-powered F150 4X4 from 2011 and 2021, there is an approximately 40% improvement in fuel economy (19.6 L/100km versus 13.8 L/100km, respectively[26]), representing significant cost and emissions savings.



Source: Stantec CEEMP Report

As a result, the lifecycle cost of an asset increases with age. The limitation in the planning process is balancing the capital requirements of replacing a vehicle early (with another traditional fuel vehicle) and electrifying other areas of the fleet. Replacing an asset early with a traditional fuel vehicle may commit the City to fossil fuels beyond when an electric alternative would be made available for that vehicle class. With these vehicles most likely to be heavy trucks or vocational vehicles that are not readily available in electric drivetrains today, or only available at a high price premium, this can have a detrimental impact to fleet electrification and extend timelines to reduce GHG emissions and meet targets.

Cascadia recommends following the guidance of the Stantec CEEMP report. In line with their recommendation, we propose that Finance and the Core Fleet Team review opportunities to replace vehicles early with a wholistic lens considering the benefit of spending those funds elsewhere. Without a doubt, vehicles that are over 10 years old and regularly utilized should be top priorities for replacement. If an electric alternative is imminently available, delaying by one or two more years should be considered to avoid buying another fossil fuel vehicle with a 10-year lifecycle. If there is uncertainty regarding electric drivetrains for the vehicle class, buying a more fuel efficient and current example provides fuel savings, and the capital cost premium associated with a future electric alternative can be redeployed elsewhere in the fleet or in adopting renewable fuels.

[26] US Department of Energy, Office of Transportation & Air Quality, fueleconomy.gov, accessed August 2021.

Recommendations Summary

In summary, the following recommendations were identified throughout the staff engagement, research, and analysis activities in developing the Green Fleet Plan, including a best practices review available in Appendix A. Each of the four primary recommendations, contain a number of actionable directives to advance the Green Fleet Plan:

Initiative	Recommendation	Next Steps	Estimated Completion	Responsibility
Investments in an Electrified Fleet	**Implement the Roadmap for ZEV adoption across vehicles that do not have market ready options:** By proactively seeking out trends for the latest EV technologies for Heavy Trucks and other specialized equipment, the City can ensure that it is doing all it can to steward an adoption of ZEVs across its fleet. This is summarized in the Fleet Replacement Scenario Analysis and supporting appendices.	1. Present to Finance and Council for approval and adoption. 2. Continually monitor the market and identify pilot opportunities. 3. Begin preliminary planning and budgeting for infrastructure investments to match annual EV purchases.	FY2022	Fleet
	Implement, Monitor, and Revise the Roadmap for Heavy Duty Zero Emissions Vehicles: Given the lack of availability for heavy duty trucks, a roadmap that identifies opportunities for adoption in the future will help accelerate the transition to EV as options become available in the market. This is discussed in more certain terms in the Fleet Replacement Scenario Analysis, with plans to 2030 including heavy duty vehicles.		FY2022	Fleet
	Action the Infrastructure Improvement Plan: As current locations are inadequately serviced for the needed charging infrastructure, the plan identifies the major gaps in infrastructure that, once addressed, will support transitioning to an electric fleet. This is discussed further in infrastructure expansion planning subsections in the Capital Investment Strategy section. Part of this should include standardizing equipment to simplify the maintenance and operation of smart charging infrastructure, and to allow for easy outsourcing if that is preferred in the future.		FY2022	Facilities, Fleet
	First Mover Advantage: There is a benefit to being first to market in placing deposits or pre-ordering electric vehicles for future fleet replacements. Especially as interest increases across the private	1. Make and maintain connections at all legacy and nascent automakers to have	FY2022	Fleet

Initiative	Recommendation	Next Steps	Estimated Completion	Responsibility
	and public sector for BEVs, demand will continue to outstrip supply. To meet annual targets, vehicles should be ordered as far in advance as possible[27].	2. Ensure the fleet team is on waitlists for all announced vehicles that are suitable for City deployment (e.g., Ford eTransit, F150 Lightning, etc.).		
	Pilot Emerging Vehicles / Technology: Funding should be available to capitalize on opportunities adopt new technologies in a temporary pilot capacity, partnering with manufacturers for real world testing. A pilot for an electric fire truck is pending, but there may be additional opportunities with Class 6 trucks. A pilot program can manage risk, space out investments, and build expertise in the technology.			
Revised Fleet Policies and Processes	**Annual GHG Reduction Targets:** Targets based on the reduction estimates as part of this GFP should be tracked through KPIs on an annual basis, with action plans developed to address missed targets.	1. A policy that prioritizes GHG reduction targets as core to operations and planning should be implemented	FY2022	Fleet, Engineering & Public Works
	Operational Requirements Review: Include an operational requirements review before replacing an asset in a like-for-like configuration, and focus on efficiency by identifying the minimum size and power (engine/motor size) necessary to fulfill their duties.	1. Develop and implement an operational requirements review process (or revise an existing).	FY2021	Fleet
	Vehicle Type Standardization: The Core Fleet Team should continue to expand and refine a process to standardize high-count vehicle classes to a single make and model. This can be completed through a requirements gathering exercise with departments and a competitive process. We strongly encourage standardizing to models that have electric powertrains immediately or imminently available.	1. Identify key vehicle classes and types that would benefit standardization. 2. Complete a requirements gathering exercise by vehicle type. 3. Determine whether an RFP or sole source approach is suitable.	FY2022	Fleet
	Implement a Minimum Utilization Metric for Purchasing Decisions: Incorporating a minimum utilization into the decision-making process for purchasing a new vehicle will help ensure that	1. Investigate low utilization assets listed in Appendix D.	FY2022	Fleet

[27] At the time of writing (September 2021), the current order backlog for Tesla Model 3's is pushing into February 2022.

Initiative	Recommendation	Next Steps	Estimated Completion	Responsibility
	departments think carefully about how vehicles will be used before buying new ones and will encourage better utilization.	2. If possible, move to shared vehicle pool or reassign. If not possible, explore the policy options for enforcing minimum utilization.		
	Create EV purchasing Policies for Non-Patrol Police Vehicles: Creating policies for only buying Zero Emissions Vehicles (ZEVs) for vehicles that have market ready EV options can ensure that the fleet is reducing its emissions to the greatest extent possible with the available options.	1. Work with the Police Board to prepare an approach to adopting electric vehicles in their patrol fleet.	FY2023	Fleet
	Align fleet GHG Strategies between Police and the City of Victoria: Currently VicPD has its budget approved by different entities with separate approaches to GHG reductions, making it difficult to work towards a common goal. The police board should formally endorse and accept this plan, committing the necessary funds to transition to electric vehicles.	1. Meet with VicPD leadership and fleet team to discuss plan adoption and budget commitment.	FY2022	Engineering, Fleet, Police
Fleet Technology & Resources	**Hire a Dedicated Fleet Analyst / Fleet Planner into the Core Fleet Team:** The City currently lacks a single resource who is dedicated to managing and maintaining all fleet tools, data, and analysis. Hiring a resource who specializes in this area can support planning, utilization tracking, and telematics system enhancements.	1. Confirm job description and core duties, including necessary skillsets. 2. Seek approval for headcount addition. 3. Recruit for position.	FY2022	Fleet
	Enhance Telematics System Capabilities: Complete Phase 2 of the Vecima implementation to further configure the solution for reporting needs. This should include investments in fuel usage, greenhouse gas emissions, and driver behavior for baselining purposes. Investments in driver behavior would allow for reporting on idling statistics and enable in vehicle alerts in the future if desired.	1. Review previous requirements and complete gap analysis. 2. Prioritize functionality and create implementation roadmap. 3. Work with vendor to complete enhancements.	FY2022	Fleet
	Create a Driver Friendly Telematics System: Given the implementation challenges around telematics, creating a			

Initiative	Recommendation	Next Steps	Estimated Completion	Responsibility
	transparent system with valuable driving data shared with drivers will encourage them to proactively improve their driving habits. This system will allow valuable data to be collected that can be used for route optimization, fleet rationalization, and greater accountability. This will also allow a clearer picture into the duty cycles for some heavy trucks that are re-purposed throughout the year. This is crucial for understanding the time to charge for each vehicle.			
	Train Fire Department Staff in Maintenance and Operations of Electric Vehicles: This step is critical to the effective transition to emergency electric vehicles and should be prioritized. There are training sessions that occur within the Province to enable teams to learn the basics of maintaining and operating electric fire trucks.	1. Identify training needs and available programs. 2. Consider partnering with a local technical institute.	FY2022	Fleet, Fire
Increase Fleet Efficiency	**Reduce Non-Productive Idling:** Using telematics and monitoring, the City can report on idling and undertake idle reduction campaigns or retrofits. The former would be focused on educating staff and discouraging idling when not necessary, potentially using in-vehicle alerts if that were to be palatable. The latter could include (but is not limited to) installing anti-idling devices, auxiliary heaters, or retrofitting beacons with LEDs.	1. This is dependent on enhancing the telematics solution.	FY2023	Fleet
	Negotiate a Renewable Fuels Contract: Discuss renewable fuel options with fuel providers to exceed emissions reductions targets. It will be important to separate these excess benefits from the electrification strategy to avoid justifications for delaying fleet electrification.	1. Identify volumes and potential delivery and storage solutions. 2. Confirm future state of City fueling stations.	TBD	Fleet
	Improve Shared Vehicle Use: Grow the shared vehicle pool and investigate partnerships with Modo or similar, with a preference for assigned parking in City locations (parkades or strategic street parking) and electric vehicles.	1. Identify vehicles and users that can be transitioned to a shared vehicle pool.	FY2022	Fleet

Initiative	Recommendation	Next Steps	Estimated Completion	Responsibility
	Rental Vehicle Policy Review: The process for the acceptable use of rental vehicles should be reviewed, and a process implemented if currently lacking. The objective is to prioritize the use of EVs, to ensure vehicle rightsizing, and to prevent departments from using rental vehicles as a way to circumvent fleet vehicle choice.	1. Complete a current state assessment of current rental policies.	FY2022	Fleet

Strategic Alignment

The Green Fleet Plan was developed to align with and leverage inputs and findings from several related initiatives. The intention of the Green Fleet Plan is to bring the City's fleet in line with the aspirations of related plans. These include:

1. **Climate Leadership Plan:** City has developed a Climate Leadership Plan (CLP) and set aggressive corporate climate targets requiring a 60% reduction of GHG emissions by 2030 and 80% by 2050 within a triple bottom line accounting system. The City has also set a 100% renewable energy target for 2050 meaning that all fuels consumed are renewable and, ultimately, have low carbon footprints.[28]
2. **Corporate Energy Emissions and Management Plan (CEEMP):** The objective of the (CEEMP) is to set the City on path to achieving the CLP GHG and renewable fuel targets by establishing short-term initiatives that build momentum and lay the groundwork for deeper energy and GHG emissions reduction actions to be implemented post-2030. The CEEMP covers a 10-year horizon from 2020 to 2030, but also considers the actions needed to achieve the 2050 targets.[29]
3. **City of Victoria Electric Vehicle Strategy:** "The Victoria Electric Vehicle Strategy charts the course to reach the City's Climate Leadership Plan ambitious target of renewable energy powering 30% of passenger vehicles in Victoria by 2030. The Strategy was developed through stakeholder engagement, a review of leading practices, and modeling of Victoria's unique transportation landscape."[30]

[28] *City of Victoria Corporate Energy and Emissions Management Plan*, Stantec, November 2020, pg. 1
[29] *City of Victoria Corporate Energy and Emissions Management Plan*, Stantec, Nov. 2020, pg. 1
[30] *City of Victoria Electric Vehicle Strategy, The road to renewable-powered mobility,* Dunsky & AES, Nov. 2020, pg. 3

Appendix A - Engagement Summary

Cascadia Partners held fleet workshops with the core fleet team, engineering / facilities, parks, fire department, police department, and finance. The content varied by audience, but generally focused on:

1. Understanding the operational needs of the department fleet vehicles;
2. Seeking input on potential fleet management initiatives seen elsewhere; and
3. Discussing the suitability of electrifying fleet assets or using alternative fuels.

Police Department Workshop

Opportunities: VicPD is open to adopting EVs that have proven use cases in other North American municipalities. They were particularly interested in examples from Vancouver and Edmonton before they considered switching patrol cars to EV. However, the team was very open to adopting EVs across its administration fleet and had already started purchasing hybrids where possible.

Challenges: The team currently faces funding challenges and have already struggled to replace vehicles in years when they were planned due to funding constraints. A move to EV would typically involve higher upfront costs and this could potentially be a major barrier in preventing the future adoption of EVs for VicPD. Furthermore, the department has not adopted a telematics system for the monitoring of vehicle movement and fuel consumption data. This exacerbates the ability to present a strong business case for the adoption of EVs to different stakeholders.

General Observations: VicPD approves and submits a budget to the Victoria and Esquimalt councils who provide the funding for fleet purchases. Given that the City of Victoria has aggressive GHG emissions reduction targets, the City needs to collaborate with the VicPD to ensure a successful implementation of the Green Fleet Plan. While the Police Department is open to adopting EVs and being a leader in this space, they do not want to be the first to test the technology. The Green Fleet Plan should be adopted by the police board and include electrification as part of their budget to meet the associated adoption of electric vehicles.

Fire Department Workshop

Opportunities: The Fire Department is very open to adopting EVs and has already purchased five Chevrolet Bolts for non-emergency related activities such as fire inspections. The team is very happy with the performance of the Bolts so far and is excited by the potential of moving some of their emergency vehicles such as fire trucks to electric as well.

Challenges: While actively exploring opportunities to go electric, the Fire Department recognizes the need to train their staff in the maintenance and operations of electric fire trucks. Currently staff have not had any access to training on these vehicles. Given that the technology used on these fire trucks is brand new, training staff in their maintenance and operation is crucial to navigating the transition to electric for emergency vehicles.

General Observations: The Fire Department has very good response times given the relatively small size of the City of Victoria (20 square kilometers). This would be advantageous from a charging perspective as emergency vehicles could potentially go several days before requiring a charge. Given that the new station would have access to exclusive DC fast charging stations, it would mean that a situation where an emergency vehicle runs out of charge during an emergency would be highly unlikely. It should also be noted that the department has a high level of public engagement resulting in 7,000+ runs a year.

Parks Operations Workshop

Opportunities: Vehicles in the Parks Department have an installed telematics system. Although this is not used currently due to business rules and concerns among some staff, it presents an opportunity for fleet rationalization and management for the future.

Challenges: There is currently little space at the three locations for vehicles in the Parks Department. This may pose a significant challenge for installing charging infrastructure for electric vehicles. Additionally, Parks uses heavy trucks for specialized purposes such as watering as well as heavy equipment. This is a challenge as certain heavy trucks do not have market ready electrical options yet. The ones that do are significantly more expensive. Consequently, there are challenges surrounding the timely adoption of electric vehicles in Parks.

General Observations: The team has begun using two Ford Focus EVs and are developing a greater understanding of their practicalities. While some users have had negative experiences with EVs, this is likely due to a lack of training, vehicle know-how, or otherwise.

Engineering Fleet Workshop

Opportunities: The Engineering Department is keen to switch vehicles to electric. There is an opportunity to right-size their fleet as some of the outfitted vans for electricians are larger than may be required for some of their jobs. This would also help reduce the capital expenditure associated with electrification.

Challenges: A major challenge to electrification is the lack of installed charging capacity. As the fleet electrifies, they will require charging stations with relatively quick turnarounds given their requirement to respond quickly to service breakdowns across the City.

General Observations: It was observed that a small portion of the fleet (5 vehicles) run close to 16 hours a day throughout the year. The vehicles are mostly parked in a single location which simplifies the infrastructure upgrades for charging. Until technology improves, it is recommended that these vehicles (typically vocational medium-duty vehicles) are retained as traditionally fueled. While a DC fast charger could work in theory, the battery degradation is likely to diminish the business case for these vehicles.

Core Fleet Workshop

Opportunities: The City currently uses a telematics system on all its vehicles. The telematics system provides an opportunity for fleet rationalization that will enable better driver behaviour, route optimization, and utilization. Additionally, the team has purchased 16 EVs including several Ford Focuses and Chevrolet Bolts. These have generally seen acceptance and suggest an opportunity for adoption of EVs across the fleet.

Challenges: Implementation challenges exist for using telematics effectively as there are rules imposed by the Union on using telematics for driver discipline and behaviour management. Furthermore, there is little accountability around how certain assets are utilized after being justified for purchase by the core fleet. This accountability is crucial for better fleet management.

General Observations: Fleet purchasing decisions are made by department heads presenting business cases to the Core Fleet. However, there is little accountability and follow up on utilization which presents a challenge for fleet rationalization. It should also be noted that the fleet is an aging fleet with many assets requiring replacement soon. This provides an opportunity for replacement with electric vehicles for vehicle classes with market ready options.

BEST PRACTICES REVIEW

To understand what strategies have worked well in the past and what have not, Cascadia looked at past work it has conducted with other municipalities in their green fleet electrification as well as conducting research on municipalities across North America. In order to evaluate the effectiveness of each strategy, Cascadia ranked them based on three criteria:

1. Impact: The effectiveness of the tactic in achieving green fleet electrification and overall improved fleet management.
2. Ease of Implementation: The ease with which this tactic was found to be implemented by fleet operators.
3. Cost & Resources: The time, money, and resources required to execute the strategy.

Past Work Review

Fleet Standardization at a Municipality

Challenge: With over 800 units of vehicles and equipment, a local municipality had different make and model preferences across departments for the same vehicle class. This presented a challenge to electrification as department requirements were based on personal preference rather than real need.

Resolution: The municipality standardized requirements for each vehicle class to enable the purchase of a single make and model across departments through a competitive bidding process. This not only enabled cost savings from a maintenance perspective but also brought the municipality one step closer to adopting electric vehicles across its fleet, standardizing their full-size pickup truck to a make and model with an electric powertrain planned for 2022 (Ford F150 Lightning). The municipality will return to market in the future, following procurement requirements, to seek competitive bids for the next contract term.

Impact: *High*
Ease of implementation: *Moderate*
Cost/Resources: *Low*

Desktop Research

Improving Fuel Efficiency at the Township of Langley

Challenge: Drivers at the Township of Langley were concerned that a GPS monitoring system with on-board computers to improve fuel efficiency would be used as a disciplinary tool.

Resolution: Management set up a kiosk in the work area with the GPS monitoring system on display. Crucially, they shared the exact information that management was seeing. This helped ease drivers into accepting this new system and implement changes to their driving behaviour such as aggressive driving, idling and harsh braking. Consequently, the township not only improved median fleet fuel efficiency by 8.5% and reduced GHG intensity by 6.1% but also gained a more positive image within the community.

Impact: *Medium*
Ease of implementation: *Moderate*
Cost/Resources: *Low*

Switching to Renewable Diesel to meet GHG reduction targets

Challenge: A municipality was struggling to meet its GHG emissions reduction targets as it tried to maintain service levels with a steadily growing population and a tight budget.

Resolution: Given the high cost associated with purchasing EVs, the municipality looked at switching most of its vehicles to renewable diesel, propane, and natural gas. This allowed the municipality to remain on track to meet its GHG emissions as it prepared to move to EVs from internal combustion engines. This strategy was particularly useful for heavy duty vehicles which tend to have high capital costs associated with EV replacement and limited availability.

Impact: *High*
Ease of implementation: *Difficult*
Cost/Resources: *High*

Full Lifecycle Vehicle Purchasing Strategies at Saanich

Challenge: In 2010, the district of Saanich set aggressive targets for GHG reductions including a goal of 50% emissions reduction by 2020 and a 50% reduction in fuel related emissions.

Resolution: The district considered the full lifecycle costs of vehicles when replacing vehicles. This not only helped ensure the purchase of fuel-efficient vehicles such as EVs but also enabled vehicle right-sizing by using the most fuel-efficient vehicles to complete tasks. These changes enabled a 14% reduction in GHG emissions and a saving of $1,230,000 over 7 years.

Impact: *High*
Ease of implementation: *Easy*
Cost/Resources: *Low*

City of Seattle

Context: As a leader in green fleet electrification, the City of Seattle provided a few lessons and strategies that have potential for adoption at the City of Victoria. Having set a goal of a 50% reduction in fleet emissions according to the Paris Climate Agreement in 2013, the city needed to find innovative strategies to reduce GHG emissions.

Challenge: In 2014, the City of Seattle had a fuel budget of $8 million, the majority of which was used by Police for patrol purposes. Given the lack of EV substitutes for vehicles at the time the City needed to find other ways to reduce fuel usage to reduce spend and GHG emissions.

Green Vehicle Selection Standards

The City created a standard by which replacement vehicles were to be purchased, prioritizing electric first, waste derived bio-diesel, other biodiesel, non-petroleum fossil fuels and finally petroleum. This aggressive tactic allowed the City to transition over 1,000 vehicles to use a B20 blend of biodiesel throughout its fleet in 2015.

Impact: *High*
Ease of implementation: *Moderate*
Cost/Resources: *Low*

Eliminating Fuel Price Cushions

The City implemented the removal of fuel price cushions in department budgets in 2019 to create a financial incentive for departments to conserve the amount of fuel they use. This conservation released $1 million in funds for other city services.

Impact: *High*
Ease of implementation: *Easy*
Cost/Resources: *Low*

Fleet Rightsizing with a Vehicle Usage Committee

To further efforts to reduce fuel usage the City set a target to reduce its fleet by 10%. To achieve this target, it set a ban on the purchase of any additional ICE vehicles that had an existing EV alternative until the department could prove its use. To ensure the plan worked a cabinet-level Vehicle Use Committee was created to ensure that no vehicles that were disposed had an adverse impact on emergency response, public safety, and other critical operations.

Impact: *High*
Ease of implementation: *Moderate*
Cost/Resources: *Low*

Appendix B – Vehicle Electrification Business Case Model

To calculate operational savings from fleet electrification, a business case model was developed, and analysis completed on each fleet vehicle asset leveraging usage data (mileage, fuel consumption, or both) and maintenance workorder data. This model was developed to calculate the cash and non-cash cost avoidance achieved through electrification, including the following categories:

1. Annual Operating Savings: Fuel and maintenance savings, less the cost of electricity used in BEVs.
2. Emissions Savings: A non-cash cost reflecting the $150 per tonne attributed to the cost of carbon.
3. Lifetime Capital Costs: Reflecting a salvage premium on disposal while recognizing the capital cost premium associated with BEVs over traditional vehicles.

Inputs and Assumptions:

Operational Savings		
Maintenance Savings	**Expected Fuel Costs**	**EV Power Cost**
Assumption: 50% of average maintenance of previous years	Based off fuel usage provided by the City Biodiesel 5% = $1.42/L Ethanol 10% = $1.62/L	Assumption: ~20% of a traditional fuel vehicle

Emissions Reduction & Carbon Price Savings			
Current GHG Emissions ($KgCO_2e$)	**EV GHG Emissions ($KgCO_2e$)**	**GHG Savings**	**EV Carbon Price Savings**
Biodiesel 5%: 2.736 CO_2e Kg/L Ethanol 10%: 2.374 CO_2e Kg/L	Electricity: 0.01 CO_2e Kg/L	Difference between EV GHG emissions and gas GHG emissions	Carbon price of $150 per tonne CO_2e is applied

Lifetime Capital Cost Differential		
EV Purchase Year	**Capital Cost Premium**	**Vehicle Salvage Savings**
Based off EV availability of the asset type and the replacement cycle	Premium for the electric version	Assumption: 10% greater salvage savings

For the proposed fleet electrification plan / scenario, the following lifetime savings were identified:

Preferred Scenario Includes Police & Patrol Smoothed Replacement	Current Fuel Type	Annual Fuel Usage (L)	Overnight Location	Replacement Cycle	Electric Version Conversion Date
	Multiple		Multiple	5 years Patrol 10 years other	2022 - 2030

Annual Operational Savings ($)				1
Annual Maintenance Savings	Current Annual Fuel Costs	EV Annual Power Cost	Annual Ops Savings	Lifetime Ops Savings
$185,494	$453,701	$90,740	$548,455	$5,655,429

Annual Emissions Reduction				2
Ex. Veh. Annual GHG Emissions ($KgCO_2e$)	EV Annual GHG Emissions ($KgCO_2e$)	Annual GHG Reduction (Tonnes)	EV Annual Carbon Price Savings ($)	Lifetime Carbon Price Savings ($)
733,263	26,094	707.2	$106,075	$1,069,514

Lifetime Capital Cost				3
EV Purchase Year	Capital Cost Premium	Annualized Capital Cost Premium	Vehicle Salvage Savings	Capital Cost and Salvage Cost Premium
2022 – 2030	-$5,790,081	-$494,481	$579,008	-$4,844,497

Annual Savings	4 EV Lifecycle Savings	Vehicle Business Case (excluding Infr.)
$654,530	$1,880,460	Yes – 122 | No – 21

4 Value of Business Case		1 Lifecycle Operational Savings		2 Lifecycle Carbon Price Savings		3 Capital & Salvage Cost
$1,880,470	=	+ $5,655,429	+	+ $1,069,514	+	- $4,844,497

A full EV lifecycle planning Excel model has been provided for use by the City of Victoria as a deliverable to accompany the Green Fleet Plan. For further detail on how the tool functions, below is an example of an individual asset using the above model:

Unit 2B015
Public Works
Ford F-150

Current Fuel Type	Annual Fuel Usage (L)	Overnight Location	Replacement Cycle	Electric Version Conversion Date
Gasoline	3241.7	Public Works	7 years (Gas) 10 years (EV)	2027

Annual Operational Savings ($) — 1

Annual Maintenance Savings	Current Annual Fuel Costs	EV Annual Power Cost	Annual Ops Savings	Lifetime Ops Savings
$633	$5,252	$1,050	$4,834	$48,340

Annual Emissions Reduction — 2

Ex. Veh. Annual GHG Emissions ($KgCO_2e$)	EV Annual GHG Emissions ($KgCO_2e$)	Annual GHG Reduction (Tonnes)	EV Annual Carbon Price Savings ($)	Lifetime Carbon Price Savings ($)
8,132.43	64.61	8.07	$1,210	$12,102

Lifetime Capital Cost — 3

EV Purchase Year	Capital Cost Premium	Annualized Capital Cost Premium	EV Extension Capital Savings	Vehicle Salvage Savings	Capital Cost and Salvage Cost Premium
2027	-$15,476	-$1,548	$1,548	$1,548	-$12,380

Average Annual Differential	4 EV Lifecycle Cost	Vehicle Business Case (excluding Infr.)
$6,044	$48,061	Yes

Positive Business Case (4)		Lifecycle Operational Savings (1)		Lifecycle Carbon Price Savings (2)		Capital & Salvage Cost (3)
+ $48,061	=	+ $48,340	+	+ $12,102	+	- $12,380

Appendix C – Priority Replacement Vehicles

The following vehicles are sorted by replacement timeline and GHG emission savings. This initial subset of vehicles focuses on traditionally fueled vehicles planned for purchase before 2030. These vehicles are aging in the fleet and requiring replacement, and so should be upgraded to BEV if given the opportunity. Note that if viewing this in 2023, vehicles replaced in 2022 with internal combustion engines should be ignored as they will be more fuel efficient and less polluting than older vehicles set for replacement in 2023 or later.

Additional detail on the recommended replacement vehicle and associated savings is available in the EV lifecycle model provided as part of this report.

Unit No.	Division	Vehicle	Purchase Year	Annual GHG Reduction (Tonnes)
4G209	Engineering and Public Works	GMC C7500	2022	18.21
4G205	Engineering and Public Works	GMC C7500	2022	9.45
4G296	Engineering and Public Works	GMC C7500	2022	9.40
3B529	Engineering and Public Works	FORD F550	2022	7.66
2C129	Engineering and Public Works	CHEVROLET ASTROVAN	2022	2.26
P500	Police	CHEVROLET TRUCK/VAN TAHOE LTZ 4DR 4WD	2023	23.71
P502	Police	DODGE CHARGER SE V8 4DR	2023	17.22
P504	Police	DODGE CHARGER SE V8 4DR	2023	17.11
P503	Police	DODGE CHARGER SE V8 4DR	2023	16.98
2B150	Engineering and Public Works	CHEVROLET SILVERADO 3500	2023	6.29
PL5	Police	TOYOTA TRUCK/VAN SIENNA LE V6	2023	5.79
2B169	Engineering and Public Works	FORD F350	2023	4.70
2B148	Engineering and Public Works	FORD F350	2023	3.41
3G573	Engineering and Public Works	FORD F350	2023	3.21
2C113	Engineering and Public Works	DODGE GRAND CARAVAN	2023	2.67
P687	Police	DODGE/RAM TRUCK/VAN RAM 1500 ST QUAD CAB 4WD	2023	2.34
2B119	Engineering and Public Works	FORD F250	2023	2.33
2C183	Engineering and Public Works	DODGE GRAND CARAVAN	2023	2.29
P515	Police	DODGE CHARGER GT 4DR	2024	17.50
P512	Police	DODGE CHARGER GT 4DR	2024	16.89
P583	Police	CHEVROLET Tahoe 4Dr 2Whdr	2024	12.87
2B192	Engineering and Public Works	FORD F250	2024	9.78
3B297	Engineering and Public Works	FORD F350	2024	8.12
2C147	Engineering and Public Works	CHEVROLET EXPRESS 1500	2024	7.98

2C179	Engineering and Public Works	CHEVROLET EXPRESS 2500	2024	7.51
2B186	Engineering and Public Works	DODGE RAM 2500HD	2024	6.46
2C187	Engineering and Public Works	CHEVROLET EXPRESS 2500	2024	6.11
2B165	Engineering and Public Works	DODGE RAM 2500HD	2024	5.82
2C157	Engineering and Public Works	CHEVROLET EXPRESS 2500	2024	4.35
P663	Police	CHEVROLET TRUCK/VAN COLORADO LT CREW CAB 2WD	2024	3.47
2C191	Engineering and Public Works	CHEVROLET EXPRESS 2500	2024	3.46
2C281	Engineering and Public Works	FORD E350	2024	3.44
2C122	Engineering and Public Works	CHEVROLET EXPRESS 2500	2024	3.02
2C181	Engineering and Public Works	DODGE CARAVAN	2024	2.89
2C137	Engineering and Public Works	CHEVROLET EXPRESS 2500	2024	2.85
2C121	Engineering and Public Works	CHEVROLET EXPRESS 2500	2024	2.81
2B168	Engineering and Public Works	FORD RANGER	2024	2.74
P681	Police	DODGE/RAM TRUCK/VAN GRAND CARAVAN SE	2024	2.50
2C140	Engineering and Public Works	CHEVROLET EXPRESS 1500	2024	2.23
2C145	Engineering and Public Works	CHEVROLET EXPRESS 2500	2024	1.95
F9	Fire	FORD RANGER	2024	1.66
2B298	Engineering and Public Works	FORD F350	2024	1.57
2C126	Engineering and Public Works	FORD E250	2024	1.09
2C182	Engineering and Public Works	FORD E250	2025	9.80
1A094	Engineering and Public Works	HONDA ODYSSEY	2025	6.76
P511	Police	CHEVROLET TRUCK/VAN TAHOE LS 4DR 2WD	2025	4.09
P689	Police	DODGE/RAM TRUCK/VAN GRAND CARAVAN SE	2025	1.39
P695	Police	DODGE GCRVN	2025	1.18
P519	Police	HONDA TRUCK/VAN ODYSSEY EX	2026	5.79
2B095	Engineering and Public Works	FORD F150	2026	5.68
P517	Police	CHEVROLET TRUCK/VAN TAHOE LT 4DR 2WD	2027	12.37
4G275	Engineering and Public Works	DODGE RAM 4500HD	2027	8.36
2C204	Engineering and Public Works	FORD E150	2027	6.90
2C097	Engineering and Public Works	GMC SAVANA 1500	2027	0.85
2C096	Engineering and Public Works	GMC SAVANA 1500	2027	0.65
5G207	Engineering and Public Works	FORD F750	2028	14.26

F4	Fire	FORD F150	2029	0.48
P585	Police	CHEVROLET TRUCK/VAN TAHOE LS 4DR 2WD	2030	21.01
P566	Police	FORD TRUCK/VAN ECONOLINE E350 SD CARGO VAN	2030	2.81
P527	Police	FORD TRUCK/VAN F150 XLT SUPERCREW 4WD	2030	1.47
2B018	Engineering and Public Works	FORD F150	2030	1.08

Appendix D – Low Utilization Assets

The following vehicles were identified to have low utilization, suggesting that they are candidates for consolidating into a shared vehicle pool or to be replaced by access to a car share. The utilization metrics displayed may not be accurate if the GPS and telematics beacon was malfunctioning, so actual utilization should be confirmed before any decisions are made regarding the vehicles.

Unit	Year	Make	Model	Department
5H092	2007	INTERNATIONAL	TANKER	Street Cleaning
1A225	2017	Ford	Fusion EV	Parking Services
2B155	2006	GMC	SIERRA 2500HD	Parks Operations
1A005	2016	FORD	FOCUS	Transportation
2B154	2003	FORD	F250	Surface Infrastructure
2B189	2007	DODGE	RAM 2500HD	Underground Utilities - Maintenance
1A008	2016	FORD	FOCUS	Underground Utilities - Construction
2B133	2000	GMC	Sierra 3500	Street Cleaning / Winter Fleet
4G910	1993	International	4600	Concrete / Winter Fleet
2B159	2007	CHEVROLET	SILVERADO 2500HD	Parks Operations
5H909	2010	Freightliner	Aerial	Electrical and Signals
2B101	2007	FORD	RANGER	Bylaw Services
1A226	2017	Ford	Fusion EV	Fleet
2C145	2006	CHEVROLET	EXPRESS 2500	Electrical and Signals
1A003	2016	FORD	FOCUS	Transportation
2C140	2001	CHEVROLET	EXPRESS 1500	Engineering Information
4C021	2018	Freightliner	M2 Step Van	Underground Utilities - Construction
1A063	2002	CHEVROLET	CAVALIER	Land Development
5G056	1997	FORD	PACKER	Solid Waste
1A070	2006	SMART	FORTWO	Bylaw Services
5G057	1997	FORD	PACKER	Solid Waste
2B221	2019	Ford	F150	Parks Operations
2B220	2019	Ford	F150	Parks Operations
2C191	2006	CHEVROLET	EXPRESS 2500	Building Maintenance
3G560	1992	CHEVROLET	C3500HD	Surface Infrastructure
4G053	1993	INTERNATIONAL	4600LP	Parks Operations
5K906	1996	INTERNATIONAL	F4900	Underground Utilities - Construction Winter

Appendix E – New Vehicle Replacement Policy

See attached document labeled accordingly to be used as a starting template for policy consideration.

About Cascadia

Cascadia Partners specializes in helping government and industry tackle their most complex problems. We focus on technology, strategy, operations, and economics, giving us a strong understanding of the public sector, and how to successfully implement projects within that context.

Our core skill set includes: Business Transformation & Technology – identifying and implementing technology solutions to enable business transformation; Strategy & Operations – addressing rapidly changing markets, increased competition, and persistent problems through operational analysis & strategic planning; Economics & Policy – conducting deep economic research, analysis, and planning to inform investment and policy decisions.

Cascadia has had the opportunity to serve and advise many of the largest organizations in British Columbia, including multiple BC Ministries, BCI, WorkSafe BC, YVR, the Port of Vancouver, QuadReal, Ledcor, TransLink, and numerous BC municipalities and industry associations

CASCADIA PARTNERS

Confident Decisions.
Positive Outcomes.

1090 Homer St. Suit 420
Vancouver BC, V6B 2W9

www.cascadiapartners.ca
hello@cascadiapatners.ca