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Fleet Assessment

Completed For: Township of Esquimalt

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In an effort to reach sustainability commitments and carbon emission reduction targets, the Township of Esquimalt has commissioned the completion of a Fleet Assessment with a focus on vehicles that can be replaced with comparable electric alternatives over the next 10 years. Transitioning to electric vehicles to help reduce emissions aligns with Esquimalt's 2022 Climate Action Plan, 2023-2026 Council Priorities, as well as Federal and Provincial targets.

The scope of this assessment included a review of 38 vehicles from both Public Works and Parks. The analysis focused on technology readiness, operational risk profiles, total cost of ownership comparisons, energy analysis and emissions reductions. This document provides an overview of the industry, methodology for the analysis, summary of results and final recommendations. The scope of this project did not include Fire Department vehicles, any infrastructure or charging-related analysis or planning.

Industry Overview

Aligning with market sentiment and government policies, many fleets are setting aggressive carbon-reduction targets. The Government of Canada has set a mandatory target for all new light-duty cars and passenger trucks sold to be zero-emission vehicles by 2035, with interim targets of 20% by 2026 and 60% by 2030. In addition, the Canadian government has set a target of 35% for all new medium and heavy-duty vehicles to be zero emission by 2030[1] and will develop zero-emission regulations for 100% by 2040. However, some vehicles and operations, such as emergency services, are expected to be exempt.

The Province of British Columbia has developed a similar target, with some key differences, to advance zero emission adoption in the interim. Notably, a zero-emission first policy will be developed for public sector fleets, setting the target that 100% of light-duty vehicles purchased will be zero-emission by

[1] "2030 Emissions Reduction Plan – Transportation," Government of Canada, accessed at https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/erp/factsheet-06-transportation.pdf

2027[2]. While this target does not include municipalities, it is notable as it includes some peer organizations. In addition, the Province of British Columbia has Zero Emission Vehicle Regulations (ZEVR) governing the implementation of light-duty zero-emission vehicles. They are currently working on developing similar regulations for medium and heavy commercial vehicles[3]. These targets have resulted in increased funding for numerous carbon-reduction initiatives across Canada.

To support these ambitious targets, the federal and provincial governments are providing significant resources for organizations to reduce the carbon emissions of their fleets. These include offering incentives intended to offset the incremental capital costs associated with the purchase for the adoption of electric vehicles. The federal incentive program provides incentives for up to $200,000 per vehicle. This incentive ranges per vehicle with approved cars eligible for approximately $5,000, approved heavy trucks eligible for $200,000, and approved vehicles with sizes between a car and heavy truck eligible for amounts between that range. In British Columbia, the provincial government has a similar program with incentives typically ranging between $4,000 and $150,000 per approved vehicle. The Federal and Provincial incentives can be combined for eligible vehicles to offset the costs up to 75% of the MSRP[4]. Funding for these incentives is topped up annually and is expected to only be offered for a few years; however, no end date is currently identified. The timing of these incentives is also aligned with increases in the carbon tax, as the cost of carbon is forecast to increase from $80 CAD/tonne in 2024 to $170 CAD/tonne in 2030. The time-limited government incentives and projected increases to the carbon tax represent just a few of the financial justifications for organizations to convert their fleets to electric.

As organizations shift towards broader adoption of electric vehicles, the demand is driving more available options in both the plug-in hybrid and full electric market. While the vehicle technology is not yet advanced enough for all duty cycles and market segments, return-to-base fleets, such as those operated by municipalities, provide the optimal operation and duty cycles for EVs. Light-duty vehicles, such as cars, SUVs and small pickup trucks, are the most advanced with numerous models available from all manufacturers. These vehicles have been demonstrating lower maintenance costs, good performance in mild climates, and longer battery life than expected. Light-duty vehicles have been successfully used in operational business for many years.

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[2] "Clean BC Roadmap to 2030," Province of British Columbia, accessed at https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

[3] "Zero Emissions Vehicle Act," Province of British Columbia, accessed at https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/clean-transportation-policies-programs/zero-emission-vehicles-act#:~:text=The%20ZEV%20Regulation%20is%20now,B.C.%20to%20meet%20consumer%20demand.

[4] "Combining Commercial Rebates," Province of British Columbia, accessed at https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/clean-transportation-policies-programs/clean-energy-vehicle-program/combining-commercial-rebates

Heavy-duty vehicles represent vehicle classes 6-8 and typically consist of dump trucks, garbage trucks, sewer combination trucks, hydro excavators and other large vehicles. These vehicles are lagging light-duty vehicles in terms of technological readiness and number of years in the market. Many heavy-duty vehicle manufacturers offer only a few vehicle options with limited real-world operating performance and reliability data. Most manufacturers only began commercial production of their heavy electric vehicles in 2021 or 2022. These vehicles are generally well-suited to predictable operational use, such as delivery services. Unpredictable uses, such as some municipal operations where vehicles are used 24/7 for snow clearing and emergency infrastructure repairs, and the requirement for complex truck bodies present some real challenges and risks. While this technology is progressing rapidly, organizations need to consider the risks to their service levels before introducing these vehicles into their fleet.

Medium-duty vehicles include Classes 3-5 and typically consist of service trucks and construction vehicles, such as Ford F350-550, Isuzu cabovers, etc. This market segment is lagging behind both light and heavy-duty vehicles in terms of electric options. Very limited options are available from any manufacturers today, however, several options are expected to be available by 2025. Similar to heavy-duty vehicles, this market segment is expected to progress quickly, and businesses should begin assessing the technology and begin planning for implementation.

Project Approach

The scope of this project involves assessing the current fleet of 38 vehicles. These vehicles are used for both Public Works and Parks operations and consist of cars, pickup trucks, medium-duty work trucks, dump trucks, sweepers, refuse trucks and aerial trucks. A complete list of the vehicles can be found in Appendix A. Operational data for these vehicles was provided by Esquimalt. This data included:

- Full vehicle description
- Annual mileage
- Annual fuel cost
- Fuel type
- Planned replacement year
- Operational use/department

This data was analyzed, and any anomalies or critical operational uses were clarified. A total cost of ownership calculation, energy analysis and emissions profile could then be developed for incumbent fuel types vs transition to electric. A critical focus when developing a transition plan for electric vehicles is to ensure risk to operations is identified and minimized. Identification of these risks includes a review of technology readiness and maturity of available vehicles combined with operational risks. Critical operations typically include snow removal, storm response, and critical infrastructure support. These operations, combined with a medium and heavy-duty electric vehicle industry that is still very much in its infancy, present one of the major challenges in developing balanced electric vehicle transition plans.

The fleet assessment and recommendations were completed with an acute awareness of these risks and attempts to balance them with a total cost of ownership and emission reductions.

Findings

The Township of Esquimalt covers approximately 10 square kms and is responsible for typical municipal services to its residents within this area. Municipalities with such a small area typically have very low annual kilometers on their vehicles and equipment. This is known as utilization and Esquimalt has done an excellent job ensuring good utilization of their vehicles. The average annual kilometres for the fleet is approximately 6,800km. Vehicles with under 5,000km annually are considered low utilization and in Esquimalt's case, the vehicles with low utilization are specialty vehicles such as a crane truck required for sewer lift station maintenance and repairs. The fact that vehicles such as this are specialty vehicles used for critical infrastructure typically justifies ownership of vehicles with low utilization. Average maintenance costs for all vehicles in the fleet also look normal with no anomalies or significantly high annual maintenance. This, combined with the annual utilization, indicates that Esquimalt's fleet size is appropriate for its service levels and that the fleet operations and maintenance are managed effectively.

Table 1 below is a list of the vehicles that are recommended as suitable for replacement with EV within the next 10 years. The list was determined using forecasts on when suitable electric options may be available in the market and risk analysis of critical services. The forecast of when suitable vehicles may be available in the market was compared with the replacement year provided by Esquimalt and where the replacement year was earlier than the forecasted year, the replacement vehicle remains as an internal combustion vehicle.

The variance of total cost of ownership (TCO) outlines the estimated difference in total cost of the vehicle over it's life. This includes capital cost, maintenance, and fuel. The variance is the difference between EV and internal combustion (ICE). Negative values mean EV is expected to be more expensive. The TCO does not factor in incentives which means for vehicles with negative values, available incentives may result in a TCO that is positive for EV.

The risk analysis included a combined review of the services provided by the vehicles and the projected technology readiness of the available EVs in the market in the replacement year. Technology readiness is typically assessed by the number of EVs that have been delivered within Canada, the duration they have been in service, and the suitability of vehicle specifications for the service. In the case of a garbage truck for Esquimalt, one has a replacement year of 2025 with another in 2028. EV garbage truck technology and reliability are not expected to be suitable for Esquimalt service requirements in 2025, but by 2028 there is expected to be good progression with consideration for the first EV garbage truck in the fleet recommended in that year. The rationale for sweepers would be considered the same as garbage trucks. However, it's recognized that some larger municipalities are introducing these vehicles as EVs and should Esquimalt also want to do so, it could be explored with more detailed analysis, contingency planning and acceptance of higher risk to service. For vehicles that provide critical services, such as snowplows, the transition to EV is considered high risk for the foreseeable future as there are no known EVs providing this service in Canada yet. They are not recommended to be transitioned to EV as part of this plan. The complete fleet list showing which vehicles provide critical service and identifying ones where technology is not yet suitable for transition to EV can be found in Appendix A.

Table 1: Summary of vehicles that can be converted to electric based on technology maturity and critical operational service

Unit No.	Year	Make	Model	Fuel Typ	Replacement Year	Variance of TCO
170	2002	Chev	Pick-up	Gas	2025	$ 43,494
189	2004	Zamboni		Propane	2025	-$ 7,936
133	1993	Chev	Pick-up	Gas	2026	$ 38,687
179	2004	Chev	Astro	Gas	2026	$ 11,280
211	2009	Ford	350 Van	Gas	2026	$ 5,565
225	2014	International	Garbage Truck	Diesel	2028	-$ 327,323
185	2004	Chev	2500 pick up	Gas	2028	$ 76,167
183	2004	Chev	2500 Crew Cab	Gas	2028	$ 60,650
212	2009	Ford	F250 pick up	Gas	2028	$ 48,360
186	2004	Chev	2500 pick up	Gas	2028	$ 15,231
184	2004	Chev	2500 pick up	Gas	2028	$ 4,037
234	2017	Ford	F450 Service Truck	Gas	2028	-$ 25,431
223	2014	Ford	F350 pick up	Gas	2029	-$ 72,859
231	2016	Ford	F250 pick up	Gas	2030	$ 36,865
200	2007	Ford	Ranger	Gas	2030	-$ 5,579
237	2019	Ford	F250 pick up	Gas	2032	$ 116,841
230	2015	Zamboni		Propane	2034	$ 118,918
243	2021	Ford	Ranger	Gas	2035	$ 51,140
236	2019	Ford	Transit high roof	Gas	2035	$ 41,627
247	2022	Ford	F250 Crew Cab	Gas	2035	$ 28,126
238	2019	Ford	F250 pick up	Gas	2035	$ 24,596
241	2020	Ford	F450 Dump Truck	Gas	2038	-$ 59,158

An energy analysis has also been completed to estimate the total power requirements when 100% of the fleet is converted to electric. The analysis was completed using average efficiency values for each of gasoline, diesel and electric vehicles. The energy density of the fuel was then converted to kWh. This method works well in duty cycles where there is a lot of idling and slow-speed use. Published fuel efficiency or energy efficiency numbers, such as what is provided by vehicle manufacturers, cannot be used in these cases as the duty cycle used for the published numbers differs significantly from Esquimalt's operational use. Detailed energy consumption per vehicle is shown in Appendix A. This information will be important for any infrastructure analysis and charging plans that may be developed in future work or projects.

The emissions profile matched to all vehicles in Table 1 being replaced with electric and in the replacement year indicated is shown in Figure 1. The baseline emission profile was determined based on the annual fuel use provided by Esquimalt. The electrification profile shows a significant drop in 2028 when a number of vehicles are converted to electric including a refuse truck. The refuse truck is notable as it's a significant contributor to the fleet emissions. Under the electrification profile, emissions drop from 211,000kgs CO_2 (211 tonnes) in 2024 to 118,000kgs CO_2 (118 tonnes) by 2033. Emissions were calculated using the Best Practices Methodology for Quantifying Greenhouse Gas Emissions[5].

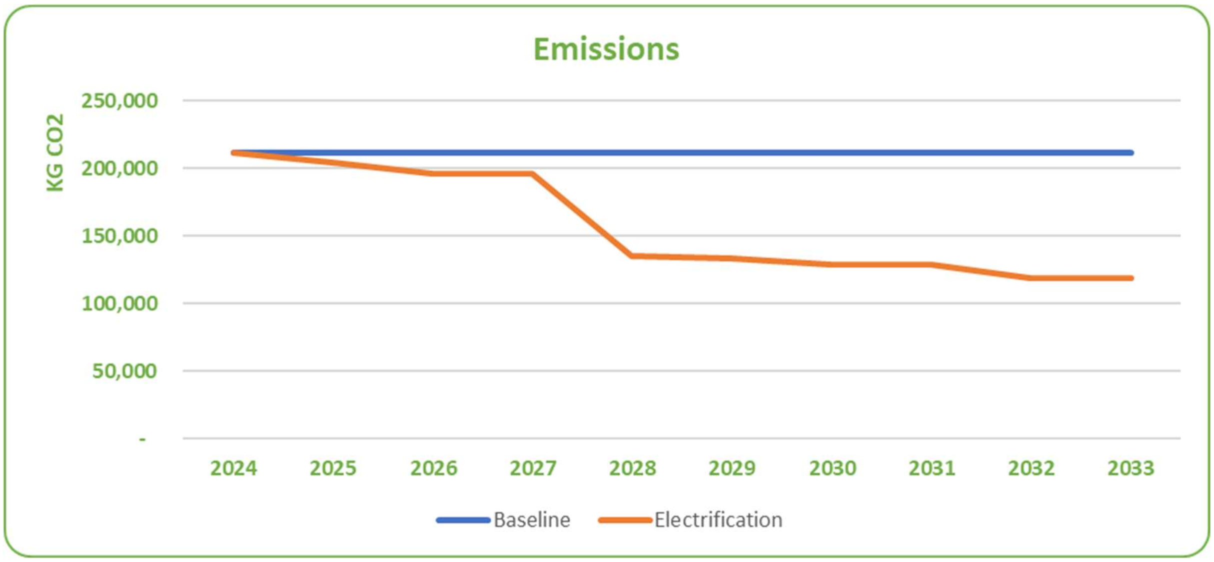

Figure 1: Fleet Emissions Profile

Finally, capital replacement costs were also determined, and the cash flow is shown below in Figure 2. This includes all vehicles whether they are internal combustion or electric. The vehicles modelled as replaced with electric are all vehicles in Table 1, regardless of total cost of ownership. The capital replacement costs do not include any applicable incentives and, therefore, represent the worst-case scenario. The cash flow shows a high variation in annual replacement costs, which also typically aligns with a higher workload for staff as more vehicles require the development of specifications for tenders as well as the outfitting of the vehicle when it arrives. Fleet management best practices typically attempt to smooth both the cash flow and workload.

[5] "2023 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions," Province of British Columbia, accessed at https://www2.gov.bc.ca/assets/gov/environment/climate-change/cng/methodology/2023_pso_methodology_for_quantifying_greenhouse_gas_emissions.pdf

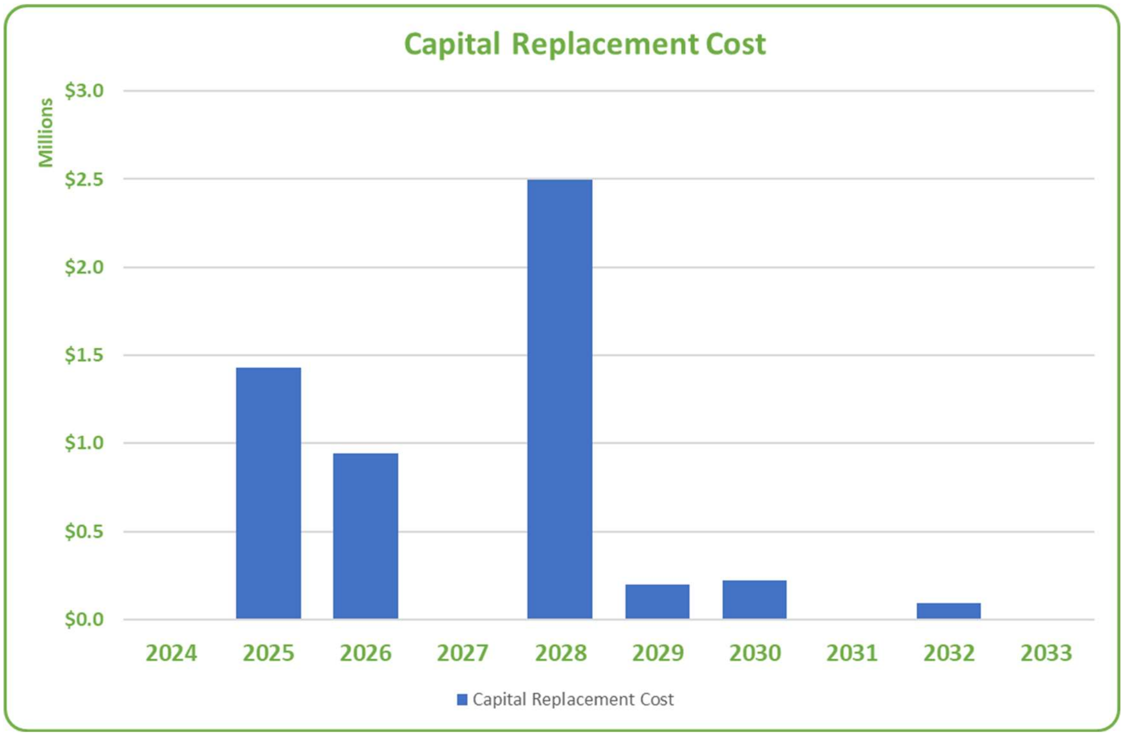

Figure 2: Capital Replacement Cost Cashflow

Recommendations

The fleet assessment confirms that electric vehicles are feasible for much of Esquimalt's fleet. In addition to the work completed under this fleet assessment project, Esquimalt should complete additional work to ensure a well-informed and planned transition to electric. Key recommendations and future work are outlined in Table 2 below.

Table 2: List of Recommendations

Recommendation	Rationale
1. Trial or demo medium and heavy-duty electric vehicles.	Enable piloting of these vehicles to better understand these emerging technologies and any associated risks. EVs have a similar form factor to gasoline or diesel, but the driver experience and maintenance requirements are quite different. Exposing drivers and maintenance staff to vehicles early will help ensure a successful change management plan and help inform vehicle specifications for future procurement processes.
2. Continue annual review of vehicle replacement plans.	This fleet strategy report does not replace the need to continue with annual updates to fleet replacement plans and the review of suitable replacement vehicles for operational use. Operational use, actual costs, and organizations need to change on a regular basis and still need to be considered when replacing vehicles.
3. Review vehicle replacement schedule and cashflow	Provided replacement dates were used for this fleet analysis. This replacement schedule results in significant variation in annual capital costs and replacement vehicle workload. Review this replacement schedule to smooth the costs and workload.
4. Budget for increased capital for EV purchases.	EVs have a different lifecycle cost profile than internal combustion vehicles. The capital cost is typically higher, significantly higher in the case of medium- and heavy-duty vehicles, and maintenance and operating costs are lower.
5. Research and apply for incentives.	Many incentives are available for vehicles, charging stations, and electrical infrastructure, which can significantly offset the costs.
6. Train maintenance staff	Maintenance staff should be trained on EV maintenance, diagnostics and high-voltage safety.
7. Procure industry recommended PPE for high-voltage vehicle safety	This is required as part of a complete EV safety and maintenance program.
8. Develop a safe work practice	A safe work practice should be developed for safely de-energizing an EV when required.

Recommendation	Rationale
9. Conduct future fleet assessments	As the City moves forward on its electrification plans, additional fleet assessments should be conducted every 3-5 years to ensure it continues to implement vehicle electrification in the most cost-effective and operationally efficient manner. Future fleet assessments are expected to be significantly smaller scope than this initial project.
10. Conduct an electrical infrastructure assessment	Electrical infrastructure should be assessed to determine if there is sufficient capacity for charging station installs.
11. Develop a charging plan	A charging plan should be developed to inform the number of vehicles per charger, size of charger, location, networking, load balancing, and other strategies to optimize chargers and minimize the impact on utility costs.

Appendix A – Fleet Data and Analysis

Esquimalt Fleet Assessment

Unit No.	Year	Make	Model	Fuel Typ	Replacement Year	TCO ICE	TCO Electric	Variance of TCO	Days in Use per Week	Estimated Daily Energy Use if Electric (kWh)	Estimated Cost at Replacemer
170	2002	Chev	Pick-up	Gas	2025	$ 157,715	$ 114,221	$ 43,494	5	26	$ 75,000
156	1998	Chev	2500 pick up	Gas	2025	$ 167,940	No electric options or technology not mature enough.	-	5	22	$ 70,000
195	2006	Dodge	2500 Crew Cab	Gas	2025	$ 163,990	No electric options or technology not mature enough.	-	5	20	$ 70,000
177	2003	Chev	2500 pick up	Gas	2025	$ 157,020	No electric options or technology not mature enough.	-	5	18	$ 70,000
189	2004	Zamboni		Propane	2025	$ 224,304	$ 232,239	-$ 7,936	5	13	$ 195,000
224	2014	International	Garbage Truck	Diesel	2025	$ 862,830	No electric options or technology not mature enough.	-	3.5	274	$ 500,000
133	1993	Chev	Pick-up	Gas	2026	$ 154,282	$ 115,595	$ 38,687	5	23	$ 75,000
210	2009	Elgin	Street Sweeper	Diesel	2025	$ 674,522	No electric options or technology not mature enough.	-	2	203	$ 450,000
204	2008	Ford	F450 Chipper Truck	Gas	2026	$ 246,027	Critical service not suitable for electric	-			$ 95,000
209	2012	Ford	Giraffe Bucket Truck	Diesel	2026	$ 488,016	Critical service not suitable for electric	-			$ 240,000
226	2014	Mack	Tandem Dump Truck	Diesel	2026	$ 694,951	Critical service not suitable for electric	-			$ 350,000
179	2004	Chev	Astro	Gas	2026	$ 117,047	$ 105,767	$ 11,280	5	10	$ 80,000
211	2009	Ford	350 Van	Gas	2026	$ 144,065	$ 138,499	$ 5,565	2	13	$ 105,000
225	2014	International	Garbage Truck	Diesel	2028	$ 852,218	$ 1,234,071	-$ 327,323	3.5	260	$ 1,000,000
203	2008	Ford	F550 Dump Truck	Gas	2028	$ 401,156	Critical service not suitable for electric	-			$ 120,000
104	2005	International	Crane	Diesel	2028	$ 592,428	Critical service not suitable for electric	-			$ 350,000
185	2004	Chev	2500 pick up	Gas	2028	$ 225,806	$ 149,639	$ 76,167	5	38	$ 95,000
183	2004	Chev	2500 Crew Cab	Gas	2028	$ 207,160	$ 146,509	$ 60,650	5	32	$ 95,000
212	2009	Ford	F250 pick up	Gas	2028	$ 192,390	$ 144,030	$ 48,360	5	27	$ 95,000
186	2004	Chev	2500 pick up	Gas	2028	$ 152,581	$ 137,349	$ 15,231	5	13	$ 95,000
184	2004	Chev	2500 pick up	Gas	2028	$ 139,128	$ 135,091	$ 4,037	5	8	$ 95,000
234	2017	Ford	F450 Service Truck	Gas	2028	$ 315,305	$ 340,736	-$ 25,431	5	40	$ 250,000
214	2011	International	Duraster Asphalt Truck	Diesel	2028	$ 592,691	No electric options or technology not mature enough.	-	5	25	$ 300,000
223	2014	Ford	F350 pick up	Gas	2029	$ 201,947	$ 274,806	-$ 72,859	5	9	$ 200,000
220	2012	Nissan	Leaf	Electric	2030	-	Already electric	-			$ 50,000
231	2016	Ford	F250 pick up	Gas	2030	$ 184,677	$ 147,812	$ 36,865	5	21	$ 95,000
200	2007	Ford	Ranger	Gas	2030	$ 111,936	$ 117,515	-$ 5,579	5	5	$ 75,000
237	2019	Ford	F250 pick up	Gas	2032	$ 285,519	$ 168,678	$ 116,841	5	48	$ 95,000
230	2015	Zamboni		Propane	2034	$ 408,075	$ 289,157	$ 118,918	5	36	$ 195,000
242	2020	Ford	F550 Dump Truck	Gas	2035	$ 345,850	Critical service not suitable for electric	-			$ 120,000
244	2023	INTERNATIONAL	HV607 SBA 4x2	Diesel	2035	$ 638,148	Critical service not suitable for electric	-			$ 350,000
243	2021	Ford	Ranger	Gas	2035	$ 193,818	$ 142,678	$ 51,140	5	24	$ 75,000
236	2019	Ford	Transit high roof	Gas	2035	$ 218,028	$ 176,401	$ 41,627	5	19	$ 105,000
247	2022	Ford	F250 Crew Cab	Gas	2035	$ 191,187	$ 163,061	$ 28,126	5	17	$ 95,000
238	2019	Ford	F250 pick up	Gas	2035	$ 187,071	$ 162,475	$ 24,596	5	16	$ 95,000
241	2020	Ford	F450 Dump Truck	Gas	2038	$ 371,830	$ 430,988	-$ 59,158	5	22	$ 240,000
252	2011	GMC	Sierra pickup	Gas	Do not replace	-	-	-			
253	2008	GMC	Sierra pickup	Gas	Do not replace	-	-	-			

Appendix B – List of Acronyms

EV – electric vehicle

ICE – internal combustion engine (typically gasoline or diesel-powered vehicle)

kWh – kilowatt hours

TCO – total cost of ownership

ZEVR – Zero Emission Vehicle Regulations