Zero Emission Vehicle Roadmap

JANUARY 2025

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INTRODUCTION

The *Zero Emission Vehicle (ZEV) Roadmap (the Roadmap)* provides an implementation plan for transitioning the City of Saskatoon's (City) fleet to ZEVs and explores opportunities to support the community's transition to ZEVs. *The Roadmap* provides the City with an implementation plan for achieving the actions and targets set out in the *Low Emissions Community (LEC) Plan*, including:

- **Action 17** - Electrify the Municipal fleet over the near-term (100% of the Municipal fleet is electrified by 2030)
- **Action 18** - Electrify the Municipal transit fleet (100% of the Municipal transit fleet is electrified by 2030)
- **Action 21** - Electrify personal vehicles through incentive programs, education, and automotive dealer partnerships (30% of all new vehicle sales are electric by 2030, 90% by 2050)
- **Action 22** - Electrify commercial vehicles through incentive programs, education, and automotive dealer partnerships (50% of all new heavy truck sales are zero-emission by 2030, 100% by 2040)

The federal government has established a ZEV sales mandate of 100% by 2035, with interim targets of at least 20% of new sales by 2026, and 60% by 2030. *The Roadmap* positions the City and the community to prepare for when Internal Combustion Engine (ICE) vehicles are no longer available.

The Roadmap uses the results of the *Zero Emissions Vehicle Feasibility Study (the Feasibility Study)* completed by AECOM to identify near- and long-term actions to progress the City toward its goals. *The Feasibility Study* provides a scan of best practices across Canada, a review of available ZEV technologies, and analysis with the BetterFleet[1] model to recommend a path for the City's fleet transition. It also reviews opportunities from other jurisdictions that could be applied in Saskatoon to support the community's transition to ZEVs.

Using the findings from *the Feasibility Study, the Roadmap* proposes a Fleet ZEV Roadmap and lists opportunities to support Community ZEV transition through potential actions that are within the municipality's control.

1 The BetterFleet platform enables fleet operators to make informed decisions about electrifying their depots and significantly reduce the cost of hardware, installation, and operations. It has served over 200 complex fleets across the Asia Pacific, Northern American and European markets; BetterFleet - Best Fleet Reporting Software

ZERO EMISSION VEHICLE ROADMAP

FLEET ROADMAP

ELECTRIFICATION OF LIGHT DUTY VEHICLES:

Transition cars, trucks, and vans, collectively referred to as light duty vehicles, in the municipal fleet to electric vehicles (EVs) over the next 16 years. Study and install required charging infrastructure, build staff capacity, and outline a financing plan to support the transition.

ELECTRIFICATION OF SPECIAL AND EMERGENCY RESPONSE VEHICLES:

Pilot ice resurfacers and mowing equipment while exploring zero emission alternatives for emergency vehicles to transition as technology improves.

HEAVY DUTY ZEV PILOTS:

Pilot battery retrofits in existing heavy equipment and purchase of new hydrogen fuel cell heavy vehicles while monitoring market availability to transition to ZEV models as technology and availability improves.

COMMUNITY OPPORTUNITIES

POLICIES, REGULATIONS, AND INCENTIVES:

Exploration and future implementation of EV-ready bylaws in new builds, loans and incentives for adding charging infrastructure to existing buildings, low-emission zones, reduced parking fees for EVs, promotion of ZEVs in Vehicle for Hire services, and facilitation of charging stations in gas stations and commercial parking lots.

EDUCATION AND AWARENESS:

Improve awareness and correct misconceptions around owning and operating EVs through events, partnerships, and online information and tools.

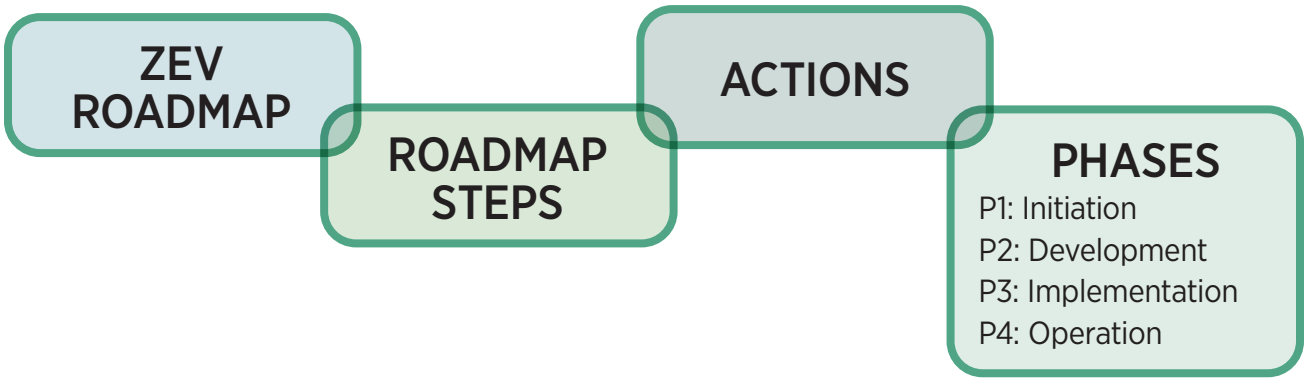
PUBLIC CHARGING NETWORK:

Starting with a public charging strategy outlining prioritized locations, amounts, and specification, explore partnerships and funding opportunities to install EV chargers throughout Saskatoon.

HOW TO FOLLOW *THE ROADMAP*

The Fleet ZEV Roadmap and Community ZEV Transition Opportunities are summarized in the infographic on page 4, each has 3 Steps to achieve our ZEV transition targets. Steps are further broken down into implementation Actions, found in Table 2, along with the phasing for each Action. In many cases, identified actions are dependent on the previous phase, and will only go ahead if recommended. In every case, specific initiatives require funding approval through the City's multi-year budget.

Table 1: How to follow the ZEV Roadmap



Phases	Description
P1 - Initiation	Includes the initial steps to define an action's scope, including an assessment of the City of Saskatoon baseline and review of best practices. The outcome of this phase is often a business case. This work is the foundation for pursuing funding applications and preparing options for budget deliberations.
P2 - Development	Includes feasibility work, research, studies, frameworks, assessments, inventories, engagement, or pilots, and is typically completed using capital funding. The result is often a decision or approval report outlining options, implications, and the Administration's recommendation on how to proceed with the initiative.
P3 - Implementation	Includes completing everything required to put Council's decision into action. The specific requirements will be defined during the development phase and may include preparing or amending a policy, bylaw, or procedure; creating a management plan or establishing a level of service; preparing or modifying a program; or acquiring land. Implementation typically utilizes capital funding with a transition plan to operating funding, which requires budget approval.
P4 - Operation phase	Includes ongoing maintenance and management of green infrastructure, or ongoing delivery of a program to meet expected service levels. Once operational, budget adjustments are made to reflect the actual program cost.

DEFINITIONS AND ACRONYMS

ZEVs are vehicles or equipment that produce no tailpipe emissions and use alternative power sources. They can include passenger vehicles, buses, trucks, motorcycles, and other modes of transportation. There are three main types:

- Battery Electric Vehicles (BEVs) – run fully on electricity, with no emissions, and are charged by plugging in to electric chargers.
- Plug-in Hybrid Electric Vehicles (PHEVs) – have both an internal combustion engine and an electric motor. They use both electricity (charged by plugging in) and gasoline/diesel. They produce zero tail-pipe emissions when using the electric motor.
- Fuel Cell Electric Vehicles (FCEVs) – use hydrogen as fuel, emitting only water vapor. FCEVs are less available than BEVs and PHEVs due to the lack of refueling stations and higher cost.

Vehicles are categorized in this report as:

- Light duty vehicles (LDVs) - includes small passenger vehicles, SUVs, light commercial (cab chassis and vans under and over 2.5 tonnes).
- Heavy duty vehicles (HDVs) - includes heavy commercial vehicles that weigh 3.5 tonnes or more.

Within this document, the ZEV transition refers to the transition from carbon-emitting ICE vehicles to ZEVs; while replacement refers to the regular and scheduled vehicle replacement cycle followed by Fleet Services.

Electric vehicles, both BEVs and PHEVs, require infrastructure to charge at workplaces, homes, and in public places. FCEVs also require infrastructure for the production and storage of hydrogen fuel. Furthermore, advancements to the electrical grid may be needed to accommodate the heightened demand for electricity resulting from the charging of BEVs and PHEVs.

The Feasibility Study uses a Well-to-Wheel emissions approach to calculate the GHG emissions, which include all fuel production, processing, distribution, and use emissions [2].

Total Cost of Ownership (TCO) is estimated in the *Feasibility Study* and used in *the Roadmap* to understand the cost of transitioning the City's fleet. TCO includes both the purchase costs and the costs to operate the vehicle over its life (fuel/electricity and maintenance). The TCO analysis provides a way to calculate and then compare the costs of owning and operating comparable vehicles over a period of time.

2 From: Emissions from Electric Vehicles - sourced from Alternative Fuels Data Center - U.S. Department of Energy https://afdc.energy.gov/vehicles/electric_emissions.html

The acronyms used in the report are listed below:

BAU	Business-as-Usual
BEVs	Battery Electric Vehicles
DCFC	Direct Current Fast Charging
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FCEVs	Fuel Cell Electric Vehicles
GHG	Greenhouse Gas
HDVs	Heavy Duty Vehicles
ICE	Internal Combustion Engine
LDVs	Light Duty Vehicles
LEC Plan	Low Emissions Community Plan
LIB	Lithium-ion Battery
PHEVs	Plug-in Hybrid Electric Vehicles
TCO	Total Cost of Ownership
VFH	Vehicles-for-Hire
ZEB	Zero Emissions Bus
ZET	Zero Emissions Technologies
ZEV	Zero Emissions Vehicle
ZEVAI	Zero Emission Vehicle Awareness Initiative

PART I- MUNICIPAL FLEET

The Fleet Roadmap

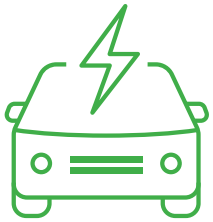
The Fleet Roadmap was developed using the results of *the Feasibility Study* and analysis conducted with the BetterFleet model. The model compared a business-as-usual (BAU) scenario against the transition scenarios: a Cost-Optimized Scenario and a Technology Leadership Scenario (see Appendix 1 for more details). *The Feasibility Study* recommended the Technology Leadership Scenario as the pathway to most quickly achieve the City's goals. However, the total-cost-of-ownership (TCO) over 16 years is $912,000 higher than the cost-optimized scenario, as shown in Appendix 1, to achieve only 441 tCO_2e more GHG reductions. For this reason, *the Roadmap* recommends the cost-optimized scenario.

The model found that 195 ICE vehicles could be replaced over the next 16 years; 194 are LDVs and 1 is an HDV in the cost-optimized scenario, which would result in approximately 13,893 tCO_2e avoided.

The Feasibility Study identified that, for the most part, HDVs and emergency vehicles do not have readily available ZEV alternatives and so a near-term ZEV transition is not possible. Instead, *the Roadmap* identifies exploratory actions and pilots that the City can initiate to transition HDVs and special and emergency vehicles as technology improves.

Table 2: Municipal Fleet Roadmap

#	Actions	2024-2025	2026-2027	2028-2029	2030-2031	2032-2033	2034-2035	2036-2037	2038-2039	2039+
Step 1. Electrification of LDVs										
1.1	**Transition and Replace 65 LDVs and 2 HDVs with EVs**	P1/P2	P3	P4						
1.1.1	Conduct a feasibility study of charging capacity for 1.1 and 1.2 and identify the sites to install them	P1								
1.1.2	Plan for implementation	P2								
1.1.3	Design, procure, and install EV charging stations		P3	P4						
1.1.4	Procure EVs		P3	P4						
1.2	**Transition and Replace 95 LDVs and 2 HDVs with EVs**		P1/P2	P3/P4	P3/P4	P4				
1.2.1	Plan for implementation		P1/P2							
1.2.2	Design, procure, and install EV charging stations			P3/P4	P3/P4					
1.2.3	Procure EVs			P3/P4	P3/P4					
1.3	**Transition and Replace 161 LDVs and 3 HDVs with EVs**			P1	P2	P3/P4	P3/P4	P3/P4	P3/P4	P4
1.3.1	Conduct feasibility for the remaining chargers and identify the sites to install them			P1						
1.3.2	Plan for implementation				P2					
1.3.3	Design and install charging stations					P3/P4	P3/P4	P3/P4	P3/P4	
1.3.4	Procure EVs					P3/P4	P3/P4	P3/P4	P3/P4	
Step 2. Electrification of special and emergency response vehicles										
2.1	**Set up a working group for special and emergency response and special vehicles**	P3	P4							
2.2	**Explore ZEV alternatives for emergency response and special vehicles**	P1	P2	P3	P4					
Step 3. Battery retrofits and hydrogen pilots for HDVs										
3.1	**Review and update the Fleet Roadmap**		P1	P2/P3	P4					
3.2	**Study and pilot HDV alternatives**			P1	P2	P3	P3	P4		
3.2.1	Conduct a feasibility study on battery retrofits in HDVs			P1	P2					
3.2.2	Conduct a feasibility study on hydrogen based HDVs with fueling stations			P1	P2					
3.2.3	Design and implement pilot projects – 1 battery retrofit and 1 hydrogen fuel cell					P3	P3	P4		



Step 1: Electrification of LDVs

The Fleet ZEV Roadmap begins with the transition of primarily LDVs to EVs, with one HDV (a heavy truck) also being transitioned. The transition plan shows a total of 328 EVs being purchased over the next 16 years, first replacing ICE vehicles in the fleet (195 vehicles) and then later replacing EVs with new EVs (133 vehicles). At the end of 16 years, the City's fleet would have replaced 195 ICE vehicles with EVs. The EV replacements are projected based on miles traveled and vehicle life cycle and are included in the total numbers of vehicles purchased, but the actions do not specify whether the purchase is replacing an ICE or an EV.

1.1 Transition and Replace 65 LDVs and 2 HDVs with EVs

1.1.1 Conduct a feasibility study of charging capacity and identify sites to install chargers

1.1.2 Plan for implementation

- 1.1.2.1 Set up a technical working group - This working group will include representatives from SaskPower, Saskatoon Light and Power, Facilities, Fleet, Parks, Transit, and Sustainability. Its objective will be to provide technical advice on electrical capacity needs, particularly in relation to future electric loads from EVs, heat pumps, and solar energy, compared to overall grid capacity.
- 1.1.2.2 Develop a financing plan for EVs and chargers – considering the number of vehicles and charging infrastructure that need to be purchased, administration will assess the financing needs and recommend options to source funding such as reserves, grants, and green loans.
- 1.1.2.3 Develop a procurement plan – administration will consider options such as multi-year contracts, role of the vendor for warranties and services, to recommend a cost-effective procurement approach that minimizes risk to the City.
- 1.1.2.4 Build staff capacity to operate and maintain EV fleets and charging stations - Training and equipping staff with the necessary knowledge and skills to efficiently and safely operate and maintain EVs and charging stations.

1.1.3 Design, procure, and install EV charging stations – A full design is required, using the results of the feasibility study, before installation can occur.

1.1.4 Procure EVs – Refer to Appendix II for the types of vehicles that could be transitioned.

1.2 Transition and Replace 95 LDVs and 2 HDVs with EVs

1.2.1 Plan for implementation

1.2.2 Design, procure, and install charging stations – The feasibility study in 1.1.1 also covers these charging stations

1.2.3 Procure EVs – Refer to Appendix II for the types and number of vehicles to be transitioned in each budget cycle from 2028-2031

1.3 Transition and Replace 161 LDVs and 3 HDVs

1.3.1 Conduct feasibility study for next chargers and identify the sites to install them

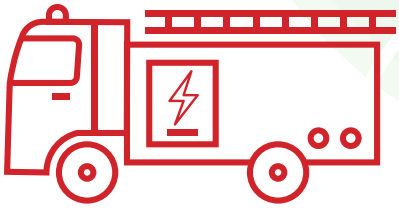
1.3.2 Plan for implementation

1.3.3 Design, procure, and install charging stations

1.3.4 Procure EVs – Refer to Appendix II for the types and number of vehicles to be transitioned in each budget cycle from 2032-2039

The electrification of LDVs is proposed to be led by Fleet Services with technical advisory support from the working group to be set up as per 1.1.2.1.

Step 2: Electrification of special and emergency response vehicles



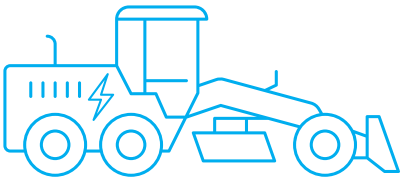
The City also owns specialized equipment such as emergency response vehicles and parks and recreation equipment. These vehicles have limited market availability for ZEV alternatives (eg. emergency vehicles) or have feasibility challenges for charging infrastructure (eg. golf carts). Many of these vehicles are not managed by Fleet and were not included in the fleet analysis in *the Feasibility Study*. Instead, discussions regarding the efforts and opportunities by other departments, including Recreation and Community Development, Saskatoon Fire, and Parks, to decarbonize their fleets and to host charging stations in the future were used to identify actions, including:

2.1. **Set up a working group** for special and emergency response vehicles with representatives from Parks, Police, Fire, Fleet, Waste, Recreation and Community Development, Saskatoon Light and Power, Facilities, and Sustainability. The objective of this group is to discuss and advise on the departmental plans for electrifying special and emergency response vehicles.

2.2. **Explore ZEV alternatives** – The departments will keep exploring ZEV alternatives with support from the working group. The Recreation and Community Development Department manages ice resurfacers and has identified a plan to replace them with electric Zambonis at five arenas, including ACT, Kinsmen, Archibald, Lions, and Cosmo. Parks also has plans to procure electric handheld equipment and has ordered an electric mower.

Action 2.1 will be led by Sustainability to set up a working group to explore ZEV alternatives (Action 2.2).

Step 3: Battery Retrofits and hydrogen pilots for HDVs



3.1. **Review and Update *the Fleet Roadmap*** - *The Feasibility Study* found that ZEV alternatives for HDVs are not readily available in the market. A review by 2029 will aim to identify ZEV options to replace HDVs and provide an updated transition plan.

3.2. **Study and pilot HDV alternatives - battery retrofits and hydrogen fuel cells**

3.2.1. Conduct a feasibility study on battery retrofits in HDVs

3.2.2. Conduct a feasibility study on hydrogen based HDVs with fueling stations

3.2.3. Design and implement pilot projects – 1 battery retrofit and 1 hydrogen fuel cell

Step 3 is proposed to be led by Fleet Services with support from Sustainability.

Financial Implications

ZEVs have higher upfront costs and require charging infrastructure but have lower operational costs than ICE vehicles due to fuel savings and lower maintenance costs. To begin transitioning vehicles to ZEV, as outlined in Table 2, additional capital will be required to cover the upfront costs. Table 3 outlines the additional capital required for transitioning the fleet, in alignment with the actions in the Fleet Roadmap. The model predicts that an additional $790,000 per year, on average, is needed to cover incremental capital costs (cost premium) associated with ZEVs. Currently, Fleet allocates $1M per year in capital to replace vehicles.

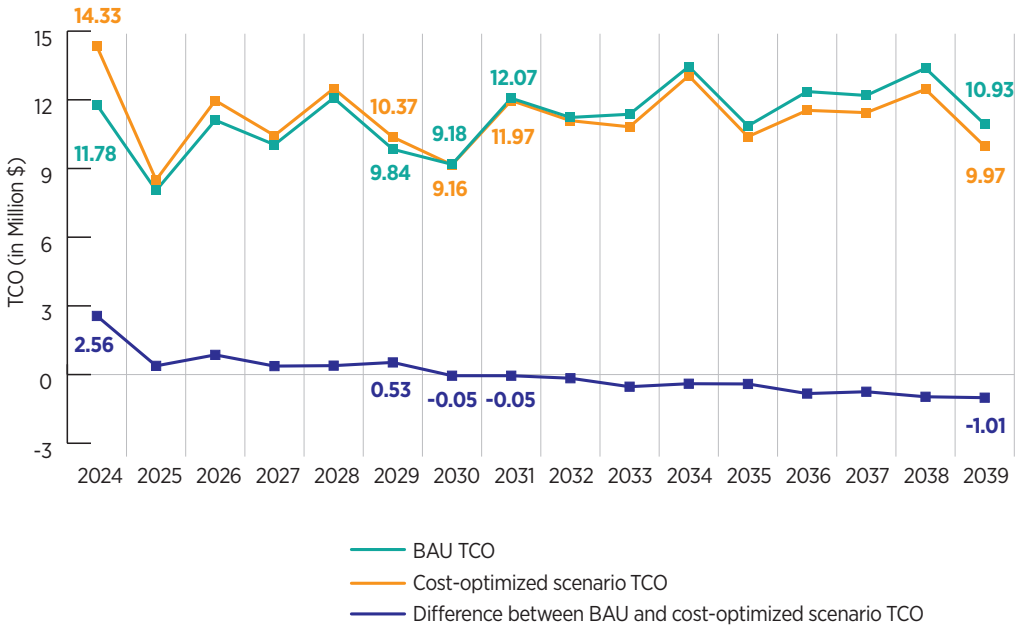
Table 3. Purchase cost of EVs with chargers

# of ZEVs	Capital cost of ZEVs + chargers ($M)	Equivalent ICE cost ($M)	ZEV cost premium ($M)
67 (65 LDVs and 2 HDVs)	$6.37	$2.84	$3.53
97 (95 LDVs and 2 HDVs)	$8.40	$4.50	$3.91
164 (161 LDVs and 3 HDVs)	$13.55	$8.30	$5.25
Total	**$28.32**	**$15.64**	**$12.69**
Avg. per year	$1.77	$0.98	$0.79

Table 3 does not include the cost savings from fuel and maintenance anticipated from ZEVs. Over time, through operational savings from fuel and maintenance, much of the cost premium will be recovered.

Figure 1 uses the BetterFleet analysis (see Appendix 1 for details) and factors in the capital and operating costs associated with the BAU and cost-optimized transition scenarios by comparing the TCO. The figure demonstrates that ZEVs will require additional capital for the first 6 years, but will have positive cashflows from year 7 onward. While these savings do not fully payback the initial investment over the 16 years, the overall shortfall is only $101,347 as compared to the BAU scenario.

Figure 1: Comparison of the cost differential of the BAU to the Cost-optimized scenario



Charging Infrastructure and Electrical Capacity

Transitioning LDVs with ZEVs requires charging infrastructure. *The Feasibility Study* estimates the number of charging stations needed at sites where fleet vehicles will be parked, as shown in Table 4. For Level 2 – 20 kW AC charging stations, a ratio of 1 EV to 1 charger is used, while for Level 3 - 50 KW fast DC charging stations, the ratio is 3 EVs to 1 charger with an appropriate energy management system [3].

3 Assumptions around charger needs are preliminary and will be further refined during design and implementation; a ratio of less than 1 Level 2 charger per vehicle will be considered.

Table 4: Required Number of charging stations - Options for Level 2 or Level 3 charging

Locations	Number of EVs that can be parked	Number of Charging stations with 50KW and 20 KW Options		Total capacity required with 50KW or 20 KW Options	
		Number of 50KW (Fast Charging DC)	Number of 20KW (Level 2 AC)	50KW	20KW
City Yards	230	77	230	3833	4600
Ave P Yards	173	58	173	2883	3460
City Hall	10	3	10	167	200
Forestry Farm	5	2	5	83	100
Landfill	15	5	15	250	300
SL&P	52	17	52	867	1040
WTP	31	10	31	517	620
Old bus barns[4]	8	3	8	133	160

Costs for charging infrastructure (equipment, installation, subscriptions, and site upgrade costs) are factored into Figure 1 and Table 3. These costs as sourced from the BetterFleet model in accordance with industry standards but may not accurately reflect the actual conditions of individual sites. Further refinement of costs will occur during design and install of charging infrastructure.

Finally, the electrical capacity of City facilities which will house the charging infrastructure must be assessed and potentially upgraded to meet charging needs. Similarly, an assessment in collaboration with local utilities must be undertaken to determine if the local grid can accommodate additional capacity.

4 The future use of this site for parking and for charging requires further consideration relative to the City's long-term ownership. Regardless, should these vehicles be relocated, charging infrastructure is still required.

Reporting on Municipal Fleet

Reporting on the progress of *the Roadmap* will occur every-second-year in conjunction with the *Climate Action Progress Report.* Progress on the Fleet Roadmap will be measured annually through the following Key Performance Indicators (KPIs):

- Number of EVs being purchased instead of ICE vehicles
- GHG emissions from the City's Fleet (as measured through the corporate (local government) GHG emissions inventory)
- Cost savings from fuel reductions and maintenance compared to electricity costs, including peak vs off-peak charging
- User experiences and EV performance (range)

The Roadmap will be reviewed approximately every 5 years with the first review planned for 2029.

Conclusion

The Fleet Roadmap starts with the electrification of the City's LDV fleet to align with available technology and allow for a cost-effective transition.

The model predicts a slightly higher overall cost as a result of the transition, amounting to an approximate loss of just over $100,000 over 16 years. The model is conservative and does not factor in other savings such as increased electricity revenue realized by Saskatoon Light & Power or cost reductions from more efficient utilization of charging infrastructure. Nevertheless, following this Roadmap should not be done for financial reasons alone and instead for the many benefits, such as:

- Smaller scale EV implementation in the near term to build expertise and iron out issues before full implementation;
- Initiate assessment and installation of charging infrastructure ahead of full ICE vehicle sales ban;
- Cost per tonne of GHG savings is better value than some other initiatives set out in the LEC Plan;
- ZEVs do not emit tailpipe emissions and lead to improved air quality with improved health outcomes for staff and the community;
- ZEVs are quieter and require less maintenance.

PART II- COMMUNITY VEHICLES

Community Barriers

Through public engagement, the following barriers to switching to ZEVs for the community were identified:

- **Lack of charging stations and range anxiety:** Most EV drivers charge their vehicles at home. In Saskatoon, Multi-Unit Residential Buildings (MURBs) represent approximately 40 percent of housing. Residents of these buildings primarily depend on the limited public charging options available. Without policies or incentives to support charging stations at MURBs, workplaces, or on the street, the charging network may not meet the needs of the community, especially for residents living in MURBS, to transition to EVs.
- **High upfront cost of ZEVs and charging:** Despite federal rebates on the purchase cost of ZEVs, the upfront cost for an EV is still higher than ICE alternatives. Even if savings from fuel and maintenance result in a similar TCO, it is still challenging for residents to make the decision to purchase an EV without up-front cost support.
- **Lack of awareness:** Without adequate knowledge about the performance, safety, environmental benefits, and total lifecycle costs of EVs, consumers may struggle to make informed decisions. This lack of awareness can lead to misconceptions and biases, causing individuals to undervalue the benefits of EVs and overestimate their drawbacks.

Community Best Practices

The Feasibility Study conducted best practise research on ZEV transitions in other muncipalities and found that:

- Zoning Bylaws requiring minimum EV-ready parking are widely adopted by municipalities to support communities in transitioning to ZEVs. Over 39 municipalities[5] have taken steps to implement minimum EV-ready parking, primarily in MURBs. This measure enhances access to home charging for residents of MURBs and leads to cost savings. A study demonstrated that implementing EV charging stations in non-EV-ready parking spaces costs 20% to 200% more than in EV-ready parking spaces.
- Cities like Vancouver, Toronto, Montreal, Calgary, and Halifax have developed EV strategies, including plans to expand EV charging infrastructure, provide incentives for EV purchases, and integrate electric vehicles into municipal fleets. These efforts aim to promote awareness and facilitate the transition to electric transportation, aligning with emission reduction goals at national and provincial levels.
- Municipal governments are leading efforts to electrify transit fleets, notably through the adoption of electric buses.

5 EV-Ready Condo Bylaw Tracker | Electric Autonomy Canada

- Cities like Toronto have taken bold and visionary steps to decarbonize their VFH fleets towards Net Zero emission. Some transport network companies like Uber have been promoting ZEVs for taxi services by providing incentives[6] to EV drivers, offering experiences of test driving in partnership with Plug n Drive[7], and providing tools[8] to support drivers' decision-making processes when purchasing an EV.
- Provincial-led initiatives include the installation of EV chargers on highways connecting cities and the implementation of additional incentives to reduce the purchase cost of EVs, complementing federal incentives.
- Provide education on decarbonization within schools.
- Supporting programs that focus on reskilling/upskilling the workforce on ZEV-specific activities.
- Promote the transition of small/medium business fleets to decarbonization.
- Explore the delivery of ZEV test-driving events.
- Explore how to meet the needs of visitors and other out-of-town users.

6 Zero Emissions Incentive (uber.com)

7 The Road to Zero Emissions | Drive | Uber

8 Uber | New Electric Vehicles Shopping Adviser (zappy-ride.com)

Community ZEV Transition Opportunities

The City can help the community transition to ZEVs by addressing and removing barriers. Table 5 identifies actionable items, based on the opportunities identified in *the Feasibility Study*, that are within the City's control.

Table 5: Community ZEV Transition Opportunities

#	Actions to Explore Community Opportunities	Responsible Departments
Step 4. Policies, Regulations, and Incentives		
4.1	**Implement an EV-ready Bylaw for new builds**	Planning and Development
4.2	**Loans for EV charger retrofits in existing buildings**	Sustainability
4.3	**Implement Low-Emission Zones**	Planning and Development
4.4	**Examine reduced parking fees**	Sustainability and Community Standards
4.5	**Incentivize and later mandate Vehicles for Hire to transition to EVs**	Community Standards
4.6	**Incentivize and later mandate chargers at gas stations and parking lots**	Sustainability
4.7	**Incentives for City employees to adopt ZEVs**	HR and Sustainability
Step 5. Education and Awareness		
5.1	**Participate in local outreach events**	Sustainability and Fleet
5.2	**Develop an online ZEV Information Hub**	Sustainability
5.3	**Explore opportunities to support low-Income/marginalized groups**	Sustainability
5.4	**Develop community partnerships**	Sustainability, Public Policy and Govt. Relations
5.5	**Study environmental impacts- EV batteries**	Sustainability
Step 6. Public EV Charging Network		
6.1	**Develop a public charging strategy**	Sustainability
6.2	**Establish a public EV charging working group**	Sustainability
6.3	**Explore partnerships with the Province, businesses, & commercial sector to install chargers**	Sustainability
6.4	**Install rapid charging networks**	Sustainability

Step 4: Policies, Regulations and Incentives

4.1 Implement an EV charging Bylaw

An EV-ready bylaw for new builds will establish minimum EV ready requirements, using an approach similar to the City of Penticton's Electric Vehicle Ready Requirements[9]. First steps will include a feasibility study, engagement, and draft bylaw.

4.2 Loans for EV charger retrofits in existing buildings

Include EV charger retrofits as eligible projects in community energy loan programs in existing single-family, multi-unit, and commercial buildings.

4.3 Implement a Low-Emission Zone

Low-emission zones are areas designated as emissions-free, noise-free spaces where only zero-emission transportation methods are permitted. A methodological approach[10] is needed for designing and pilot the low-emission zone that will include:

- Low-emission zone's size, scope, and framing based on local evidence on local pollutants, exposed population, congestion problem, demography, and modal split.
- Legal basis for establishing and enforcing a low-emission zone.
- Real alternatives by investing in walking, cycling, public transport, and electric vehicle charging infrastructure.

4.4 Examine parking advantages for EV drivers through reduced parking fees

This will first require an assessment to ensure that the proposed fees exemptions are allowed within Saskatoon's Bylaw framework. Then, a study will be conducted on the feasibility of increasing the number of EVs through reduced parking fees.

4.5 Incentivize, and later mandate, Vehicles for Hire (VFHs) to transition to ZEVs

Vehicles for hire (taxis and transportation network companies) are an essential service. This sector is closely regulated by the City, and as such, engagement with this complex stakeholder group is key to participating in the transition to ZEVs by electrifying transportation services. The City will explore ways to encourage VFHs to electrify their fleet, including[11]:

- Provide financial incentives to VFHs to encourage ZEVs.
- Assess the viability of mandating a minimum number of ZEVs in VFH fleets through the relevant bylaw.

9 Electric Vehicle Ready Requirements- Example

10 C40 on How to design Low-Emission Zone- https://www.c40knowledgehub.org/s/article/How-to-design-and-implement-a-clean-air-or-low-emission-zone?language=en_US

11 Given approaches are inspired by Toronto EV strategy- https://www.toronto.ca/wp-content/uploads/2020/02/8c46-City-of-Toronto-Electric-Vehicle-Strategy.pdf

4.6 Incentivize and later mandate chargers[12] at gas service stations and commercial parking lots

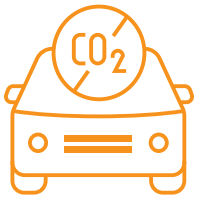
The City will explore ways to encourage gas service stations and commercial parking lots to install EV charging stations, including:

- Incentivize the adoption of ZEVs through reduced business licensing fees for gas stations that are early implementers of charging stations.
- Explore requirements for a minimum number of charging stations through business licensing.

4.7 Incentives for City employees to adopt ZEVs

The City will assess incentives and disincentives to encourage adoption of ZEVs. These may include changes to the car allowance policy, increased access to charging, corporate car loans, or other employee benefits.

Step 5: Education, Awareness, and Partnership



5.1 Participate in outreach events

The City will continue participating in local outreach events such as Charged Up and Drive Electric Earth Week held by community partners and will explore opportunities to for additional events with broader audiences and messages. Using funding from NRCan's Zero Emission Vehicle Awareness Initiative (ZEVAI), the City is planning a matchmaking event between ZEV technology seekers and solution providers in 2025.

5.2 Develop an online ZEV information hub

The City will design and host an EV information hub with user-friendly information for prospective EV-users. The site will host FAQs, information about EVs and chargers, and evidence-based data on costs, range, and reliability to help residents make informed decisions about purchasing and using EVs.

5.3 Explore opportunities to support Low-Income/marginalized groups

The City will evaluate the impacts of all the actions on low-Income and marginalized groups with the goal of embedding Diversity, Equity and Inclusion (DEI) aspects in developing education and outreach.

5.4 Develop community partnerships

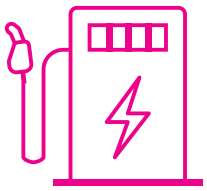
The City will identify the key areas of partnership and partners on ZEV, develop an engagement plan with potential opportunities for experience sharing, advocacy, and identifying pipeline of projects where joint work can be conducted with partners.

5.5 Review the environmental impacts of EV batteries

The City will conduct a study on the environmental impacts of EV batteries in the upstream (mining and extraction of critical minerals) and downstream (EV battery recycling and environmental disposal).

12 https://vancouver.ca/streets-transportation/ev-charging-at-gas-stations-and-parking-lots.aspx

Step 6: Public Charging Network



6.1 Develop a public charging strategy

A public charging strategy will prioritize locations for chargers, estimate the number of charging stations required in Saskatoon, determine their technical specifications and electrical capacity requirements, and outline plans for electrical capacity expansion, if needed.

The strategy[13] will have the following key actions:

- **Plan an optimized EV charging network** using predictive tools to analyze data, anticipate EV adoption, and identify optimal charger locations.
- **Select optimal charger locations and speeds** aiming for a balanced deployment of both DC Fast chargers and Level 2 chargers in various locations catered to diverse driver needs.
- **Pilot EV chargers in downtown or priority neighborhoods** to aid in increased tourism and local business patronage. (*The Feasibility Study* includes an assessment of the demand for public charging in the neighborhoods in Saskatoon.)
- **Collaborate with turnkey providers** for planning and engineering and engage local trades for construction and maintenance. This enriches projects with local expertise while boosting the economy and job market.
- **Construct and install efficiently** using a "dig once" strategy, focusing on long-term adaptability, and minimizing future disruptions. This method can reduce costs, preserve city aesthetics, and enable multi-use infrastructure, like micro-mobility and 5G networks.
- **Maximize utilization and communication** of EV charging networks by informing potential EV owners about new charging stations through various channels like social media, local media, and direct notifications.
- **Plan for electrical capacity requirements and integration of renewable energy.**
- **Conduct engagement** to consult with stakeholders on the public charging strategy.

6.2 Establish a public EV charging working group.

A working group, including both internal and external stakeholders such as SaskPower, SaskEV, Saskatoon Light & Power, and charging network providers to help develop the public charging strategy and understand charging network opportunities and barriers.

6.3 Install public charging stations through partnerships

The City will explore partnerships with the Province, local businesses, and the commercial sector to identify opportunity to jointly finance and install charging stations.

6.4 Explore rapid charging networks

Rapid charging networks, also called DC Fast Chargers, will be explored for installation in alignment with the recommendations in the public charging network and will require partnerships with SaskPower and charging network providers.

13 Volta Charging | Navigating Urban Public EV Charging: Key Strategies for Cities

Monitoring Progress On Community Opportunities

The Community Roadmap identifies policy and incentive measures that are within the City's control, starting with low-hanging fruit such as ensuring new builds are EV-ready and moving to more challenging policies such as low emissions zones and requirements for charging infrastructure. Alongside these policy measures, the *Community Opportunities* outlines a path to use partnerships to install an EV charging network and a suite of educational and awareness tools.

Progress on the Community Roadmap is more challenging and will include progress on the actions as well as the following KPIs identified in *the Feasibility Study*:

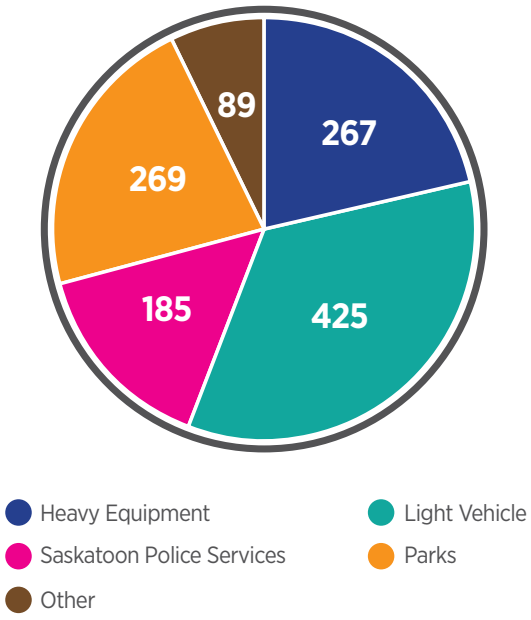
- Number of registered EVs in Saskatoon
- Number of EV charging stations and charging useage data
- GHG emissions from transportation (measured in the community GHG emissions inventory)
- Local noise levels and air quality
- New jobs and increased investment in the ZEV sector
- Access to public charging in vulnerable neighbourhoods and MURBs
- Access by shared mobility services to EV options.

The Roadmap will be reviewed approximately every 5 years with the first review planned for 2029.

APPENDIX I: FLEET ANALYSIS

Most of the City's fleet is managed by Fleet Services and is categorized within the *2023 Corporate Fleet Services Asset Management Plan*[14] as Heavy Equipment, Light Vehicles, Saskatoon Police Service vehicles, Parks, and Others, as shown in Figure 2. Exceptions that are managed by other City departments include small parks maintenance equipment (i.e. less than $25,000), ice resurfacers, golf carts, and vehicles managed by Saskatoon Fire (fire apparatus). The City currently has 5 electric vehicles in its fleet including 4 sedans and a ½ ton truck. The Transit Fleet is managed by Saskatoon Transit and is not included in this roadmap.

Figure 2: City's fleet inventory, 2023 Corporate Fleet Services Asset Management Plan



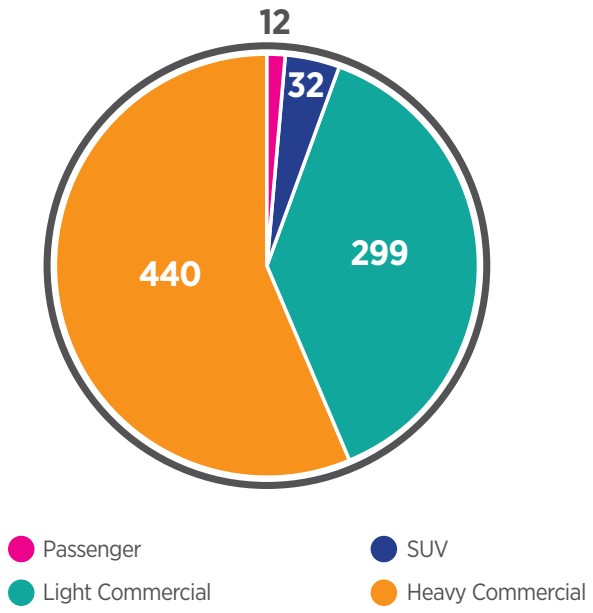
14 *2023 Corporate Asset Management Plan*, Saskatoon Fleet Services - https://pub-saskatoon.escribemeetings.com/filestream.ashx?DocumentId=189419

An analysis was conducted for *the Feasibility Study* using BetterFleet[15] modeling software. The BetterFleet model compared three scenarios to identify what vehicles could readily be transitioned to ZEVs, what the cost of the transition would be, the future fuel/electricity use, and the resulting GHG reductions. The three scenarios are described in Figure 4.

A total of 783 vehicles were included in the modeling. Vehicles included in the analysis were those categorized as Heavy Equipment, Light Vehicles, and some of the group defined as Other from the Corporate Asset Management inventory from Figure 2. Vehicles not included in the modeling included those used by the Saskatoon Police Service (due to a lack of acceptable alternatives), vehicles that are at the end-of-life, and vehicles not currently in active use.

As shown in Figure 3, the BetterFleet model categorizes vehicles into passenger (small hatchback cars), SUV, Light Commercial (Cab Chassis and Vans under and over 2.5 tonnes), and Heavy Commercial (3.5 tonnes or more). For analysis purposes, all vehicles that weigh 3.5 tonnes or less are referred to as LDVs (passenger, light commercial, and SUV) and vehicles that weigh more than 3.5 tonnes are referred to as HDVs (heavy commercial).

Figure 3: Vehicle Asset Classifications in BetterFleet



15 The BetterFleet platform enables fleet operators to make informed decisions about electrifying their depots and significantly reduce the cost of hardware, installation, and operations. It has served over 200 complex fleets across the Asia Pacific, Northern American and European markets; BetterFleet - Best Fleet Reporting Software

The modeling considers future technological and cost trending of existing ZEV models, diesel and gasoline fuel prices, and electricity rates to identify which vehicles could be transitioned and to estimate costs, fuel-use, and GHG emissions. The model proposes ZEV alternatives that match the existing ICE vehicle's specifications and duty cycles with HDV matches based on gross vehicle mass. Daily utilization requirements were approximated based on annual mileage figures discussed with Fleet. EV charger types and quantities are used to forecast the chargers needed for each scenario. GHG estimations consider well-to-wheel emissions.

The BetterFleet model assumes that the City's fleet won't expand or contract. Hence, the model may need to be rerun with a revised number of vehicles to accommodate the predicted growth.

BetterFleet Results

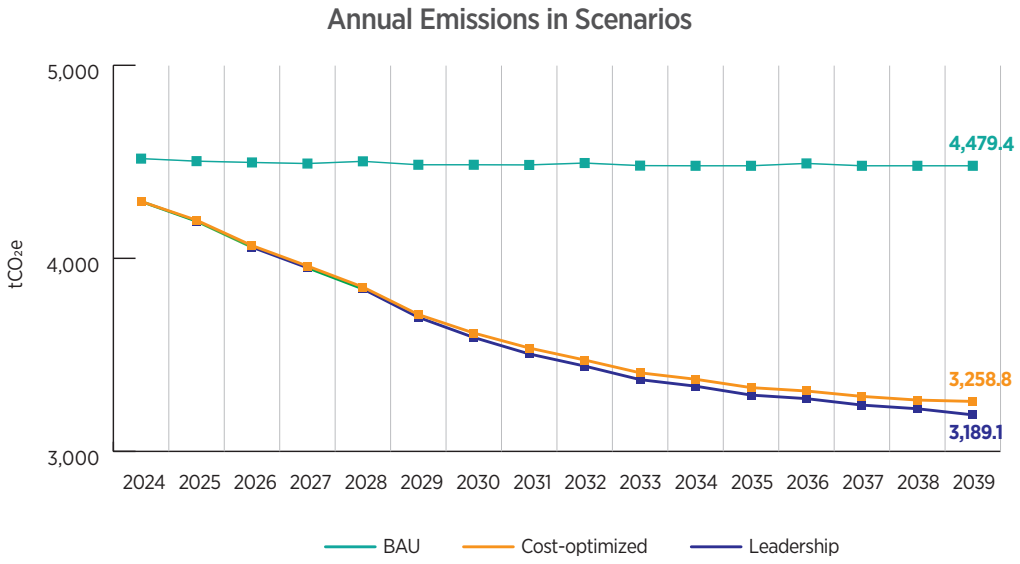
The BetterFleet model found that 195-215 ICE vehicles could be replaced with ZEVs over the next 16 years. The ZEVs would also require replacement on a regular schedule (i.e. every 8 years), in total 328 EVs would be purchased. The vehicles proposed for transition were primarily LDVs due to the limited market availability of ZEV for HDVs. Figure 4 compares the three scenarios.

Figure 4: Comparison of ZEV Transition Scenarios to a Business as usual approach.

Business-as-usual (BAU)		Cost-optimized		Technology Leadership	
The City continues with like-for-like replacement of ICE vehicles; no new electric or battery electric vehicles are procured.		ZEV transition occurs in the most cost-optimized manner by selecting feasible ZEV alternatives where possible to meet GHG reduction objectives.		Positions Saskatoon as an industry leader by halting all purchases of ICE vehicles provided there is a suitable ZEV alternative.	
Number of Vehicles in the Fleet by 2039 **ICE** *(each = 100 LDVs; each = 100 HDVs)* | **EV/PHEV** *(each = 100 LDVs; each = 100 HDVs)*					
ICE **339 LDVs** **440 HDVs**	**EV/PHEV** **4 LDV** **0 HDV**	**ICE** **149 LDVs** **439 HDVs**	**EV/PHEV** **194 LDV** **1 HDV**	**ICE** **135 LDVs** **433 HDVs**	**EV/PHEV** **208 LDV** **7 HDV**
Total Cost of Ownership by 2039					
$179.9M		**$180.0M** ($100K more than BAU)		**$180.9M** ($1M more than BAU)	
GHG Emissions Produced by 2039 *(each = 10,000 tonnes CO_2e)*					
71,826 tCO_2e		**57,933 tCO_2e**		**57,492 tCO_2e**	

Well-to-Wheel GHG emission reductions are anticipated from both transition scenarios as compared to the BAU. Over 16 years, the cost-optimized scenario would reduce emissions by approximately 13,892 tCO_2e and the technology-leadership scenario by 14,333 tCO_2e. As shown in Figure 5, by year 16 approximately 3,000-3,300 tCO_2e would be emitted as compared to 4,500 tCO_2e in the BAU scenario.

Figure 5: GHG emission reductions in cost-optimized (Economic) and technology leadership scenario with respect to BAU



ZEV Transition Cost Analysis

The BetterFleet model identified the TCO of the three scenarios. While the TCO of the technology leadership scenario was $1,013,980 higher than the BAU scenario, the cost-optimized scenario was $101,347 greater than the BAU. For this reason, the cost-optimized scenario was identified as the preferred scenario and is used to further analyze the cost to transition the fleet.

Table 6 provides a breakdown of the full fleet costs (LDVs and HDVs), as exported from the BetterFleet model, for both the BAU and cost-optimized scenarios.

Table 6: Break down of Cost of BAU and Cost optimized scenario over 16 years for the complete fleet (LDVs and HDVs)

#	Item	BAU scenario cost in $	Cost optimized scenario -ZEV transition cost in $	Cost premium[16] for ZEV transition in $
A.1	Purchase Cost	156,309,346	164,794,652	8,485,306
A.2	Residual Cost[17]	56,529,676	58,490,019	1,960,343
A.3	Charging Cost	NA	4,204,130	4,204,130
A.3.1	Charging equipment	NA	1,137,090	
A.3.2	Charging Infrastructure upgrades	NA	3,067,040.00	
A	**Capital Cost**	**99,779,670**	**110,508,763**	**10,729,092**
B.1	Fuel Cost	44,159,114	33,906,405	(10,252,708)[18]
B.2	Electricity Cost	26,280	1,252,850	1,226,569[19]
B.3	Taxes	3,122,506	3,311,740	189,233
	Other	TBD[20]		
B	**Operating Cost**	**47,307,901**	**38,470,997**	**(8,836,904)**
C	**Maintenance Cost**	**32,817,387**	**31,026,547**	**(1,790,840)**
	Total Cost	**179,904,960**	**180,006,307**	**101,347**

16 Cost premium = Cost Optimized ZEV Transition Scenario cost – BAU scenario cost

17 Residual cost is the amount that the vehicle is sold for

18 Negative cost premium indicates savings from fuel and operating/maintenance

19 Benefits and ROI from electricity sourced by Saskatoon Light & Power are not considered in this estimate

20 Costs associated fuel handling and storage, including fuel facility maintenance, upgrades, environmental compliance and site remediation are not included in this estimate. Preliminary costs associated with the Corporate fuel program are estimated at $175K for annual operating and $2.1M capital for underground tank replacements and remediation.

The total cost, shown in Table 6, is the sum of the capital cost of annual replacements, the maintenance cost, and the operating cost.

- **Capital Cost** is the purchase cost minus the residual cost plus any EV charging infrastructure costs. The capital cost is higher for the ZEV transition scenario because of the higher upfront cost of ZEVs plus the added costs of charging stations ($12.68 million without residual cost deducted and $10.72 million after residual cost deducted).
- **Operating Cost** includes fuel, electricity, and taxes. In the ZEV transition scenario, fuel (gasoline) is $10.25 million less than the BAU scenario but electricity increase by $1.22 million resulting in a cost savings of $8.83 million.
- **Maintenance Cost** of the ZEV transition scenario is lower than the BAU by $1.79 million.

Together, the negative operating and maintenance cost premiums and the capital cost premium for ZEV transition are adding to a net premium of $101,347 over 16 years. Capital and operating costs associated with fuel tank infrastructure have not been included in this analysis. Revenues from the sale of electricity in Saskatoon Light & Power's service area are also not included.

APPENDIX II: TRANSITION AND REPLACEMENT SCHEDULE OF EVS

Table 7 provides the LDV replacement schedule, including which makes of vehicles will be replaced, over the next 16 years (adapted from the replacement schedule found in *the Feasibility Study*).

Table 7: EV type and numbers to be transitioned and replaced each budget cycle

Year	Budget Cycle	EV Type					
		Small Crossover SUV	SUV	Pickup Truck	Van	Heavy duty trucks	Total EVs
1	2026-2027	5	0	11	0	1	**17**
2		0	2	9	0	0	**11**
3		2	1	12	1	1	**17**
4		3	0	18	1	0	**22**
5	2028-2029	10	0	15	0	0	**25**
6		5	0	23	0	1	**29**
7	2030-2031	0	0	22	2	0	**24**
8		1	1	16	0	1	**19**
9	2032-2033	4	0	19	0	0	**23**
10		2	0	11	0	0	**13**
11	2034-2035	5	0	25	1	1	**32**
12		0	0	15	0	0	**15**
13	2036-2037	2	0	14	1	0	**17**
14		5	3	19	0	1	**28**
15	2038-2039	3	1	14	0	0	**18**
16		1	0	16	0	1	**18**
Total		**48**	**8**	**259**	**6**	**7**	**328**

City of Saskatoon